Spatial Organization of Shophouses on Hung Vuong Street in Danang towards Green Building – References from Hoian Ancient Shophouses

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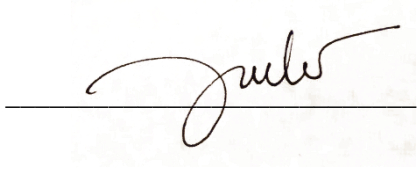
DECLARATION OF ACADEMIC HONESTY

I hereby declare to have written this Master's Thesis by my own, having used only the listed resources and tools. It is well known to me that a false declaration is deemed to be an offence against the examination regulations of the **Technical University of Darmstadt**.

(Darmstadt, 29th November 2016) 

Le Thi Kieu

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ABSTRACT

Towards a sustainable urban development in Vietnam, several aspects have been taken into account. Due to its significant strengths, Green Building is not an exception. Moreover, since housing is the basic demand for every city, the effectiveness of its architectural design is always the priority. Therefore, possibilities of Green Building application on housing is increasingly concerned.

In business towns like Danang city, shophouses account for a great number of houses due to the benefits of their multiple functions. In terms of spatial organization, however, they seem to face some challenges in the process of developing towards Green Building. Hence, it would be the main focus of the research with the case study of shophouses on Hung Vuong Street, Danang. Moreover, the goal of development is defined, and the possible solutions to reach there is referred from Hoian ancient shophouses.

The qualitative research approaches the questions by desk review, observation and interview. By the methodology, the research finds out that the shophouses designed following the linear spatial organization as in a typical townhouse, the goal of development to be reached in 2050 is to meet the minimum requirements of the local Green Building rating system, and the selected elements from the local traditional shophouses are introduced to use on the way.

By the findings, the study is in hope to contribute another helpful source for practical application in architecture design and theoretical reference for further relevant research.

Keywords: Spatial Organization, Shophouse, Green Building, Hung Vuong Street, Danang, Hoian, Vietnam

LIST OF ABBREVIATIONS

URA – Urban Redevelopment Authority of Singapore

USGBC – The US Green Building Council

VGBC – The Vietnam Green Building Council

LEED – Leadership in Energy and Environmental Design

GREEN STAR – National and voluntary rating system for buildings and communities by Australian Green Building Council

BREEAM – Environmental assessment method and ratings system for master planning projects, infrastructure and buildings by British Building Research Establishment

BCA – Building and Construction Authority of Singapore

LOTUS – Green Building rating system issued by VGBC

LOTUS R – LOTUS for Residential buildings

LOTUS BIO – LOTUS Buildings in Operation Pilot

UNESCO – The United Nations Educational, Scientific and Cultural Organization

PCI – Provincial Competitiveness Index

UPI – Urban Planning Institute

EVN – Electricity Vietnam

ASEAN ESC Awards – ASEAN Environmental Sustainable Cities Awards

BRT – Bus Rapid Transit

TABLE OF CONTENTS

1. Introduction

The first chapter of the thesis introduces about the research background, questions, objectives and general structure by the outlines. The described content is expected to offer the readers an overall view and the first understanding of the study.

1.1. Research background

Commonly found in Southeast Asian cities, **shophouse** is a vernacular architectural building type that combines both residential and commercial functions. Located usually on the busiest streets in towns, the houses are easily recognized by their typical features of narrow building forms and the small façades full of goods and advertising products. Due to those characteristics, spatial organization in shophouses have had some limitation. Hence, citizens living in shophouses are facing difficulties in terms of thermal comfort and energy consumption. The situation is becoming worse due to the higher migration into big cities for business recently. In order to help bringing a better living conditions as well as reducing energy demands for the settlers, the factors and analysis of the matters are in need to be studied, and proper architectural recommendations should be offered.

Among the possible approaches for these issues, learning from local traditional should be an appropriate way due to the similarities in forms, functions, climatic conditions, and design mind set bases between old and new houses. In addition, the application of valuable references from traditional into late architecture also interestingly has a great meaning in the process of sustainable urban development. Based on this background, **the research is in hope to analyse the current spatial organization of recent shophouses in big cities, state their goal of development**, and later on, **introduce a proper approach for the issue via references from successful old shophouses** built in the similar social – economic and natural conditions.

Located in the central of Vietnam, **Danang** is a coastal city with fairly rapid development over the last decades. The young dynamic city keeps attracting more and more business coming to town, and for the demands, there are even more shophouses constructed and operated on narrow land plots in dense areas. While it helps build the city image and bring economic benefits to the city, the trendy shophouses in the centre, such as those on Hung Vuong Street, consumes a high level of energy due to their operation. Towards “An Environmental City” in 2020, Danang, the city with the highest rate of urban population in Vietnam, is currently in need of solving this issue of energy demand to be a more eco-friendly city. (*Energizing Green Cities in Southeast Asia*, 2013)

Meanwhile, only 30 km from the centre of Danang, **ancient shophouses in Hoian Old Town** are well-known not only by their conserved beauty and lifestyle, but also for the effective architectural design in terms of energy saving and eco-friendliness. Having almost similar climatic conditions,

these traditional houses are able to be studied for potential lessons towards “Green building” that could be applied in the case of shophouses in Danang in a certain extent.

1.2. Research questions

Due to the awareness of the importance of sustainable architecture in the current context of Danang city and the great meaning to transfer traditional solutions into late architecture, the research is carried out on shophouse architecture in a neighbourhood in Danang city towards Green Building, mainly on **qualitative study** about the actual problems, the major factors of the issues and potential solutions learnt from Hoian ancient shophouses. In order to be more specific and practical, a certain number of **shophouses on Hung Vuong Street**, the busiest and oldest business street in town, are taken into the research as the case study. Therefore, the research questions could be stated in the order as below.

1. How is the spatial organization of shophouses on Hung Vuong Street, Danang?
2. What is the goal to develop those shophouses in the urban context of Danang in 2050?
3. Referring from Hoian ancient shophouses towards Green Building, what could be done for those shophouses in terms of spatial organization?

1.3. Research objectives

By this research, it is expected to describe and analyse the current challenges of spatial organization of shophouses on Hung Vuong Street, Danang, in the perspective of “Green Building”. In addition, references from those in Hoian Old Town are studied to give recommendations concerning architectural solutions for shophouses in Danang city towards “Green Building”. The findings, consequently, might be practically applied in architecture design and theoretically referenced for further related research.

1.4. Research outlines

The research is divided into 7 chapters.

Chapter 1 introduces the general information about the research.

Chapter 2 describe the methods of approaching as well as the scope and limitation of the study.

Chapter 3 reviews on paper works on the concepts used in the research, Green Building, green elements of Hoian ancient shophouses, and the impacts on the development of shophouses on Hung Vuong Street.

Chapter 4, 5 and 6 answer the three research questions respectively.

Chapter 7 discusses the findings as well as gives conclusion for the overall thesis.

Chapter 1: Introduction

1.1. Research Background
1.2. Research Questions
1.3. Research Objectives
1.4. Research Outlines

Chapter 2: Methodology

2.1. Research Approach
2.2. Scope and Limitation

Chapter 3: Literature Review

3.1. Definition
3.2. "Green Building"
3.3. Green elements of Hoi ancient shophouses
3.4. Impacts on the development of the shophouses on Hung Vuong Street, Danang

Chapter 4: Spatial organization of shophouses on Hung Vuong Street, Danang

4.1. Overview of the studied shophouses
4.2. Typical programming and spatial organization
4.3. Consequences of spatical organization of the shophouses in the perspective of Green Building

Chapter 5: The goal to develop the studied shophouses in 2050

5.1. The role of shophouse development on Hung Vuong Street in Danang in 2050
5.2. The goal of shophouse development on Hung Vuong Street in Danang in 2050

Chapter 6: The proposals in terms of spatial organization for the studied shophouses based on references from Hoian ancient shophouses

6.1. Rationale to refer from Hoian ancient shophouses
6.2. Comparison between shophouses on Hung Vuong Street and Hoian ancient shophouses

Chapter 7: Discussion and Conclusion

7.1. Discussion
7.2. Conclusion

Figure 1. Thesis structure, A1

2. Methodology

This chapter describes the approaches that the author uses to answer the research questions. The scope and limitation are stated for better understanding the scale of the study.

2.1. Research approach

In order to answer the research questions, the mixed method of data collection are carried out as in the table below. Later on, data are qualitatively analysed to figure out the findings.

Table 1. Summary of research approaches, T1

Objectives	Details of data	Source of data	Approach
1. To find out the spatial organization of shophouses on Hung Vuong Street, Danang	- The history of foundation; the economic, natural and social impacts on shophouses - The description and analysis of programming, spatial organization and their effects on energy consumption	- Relevant books, research and articles - Documents taken from authority (Hai Chau district and its wards) and related companies (EVN[1])	Mixed method: - Desk review - Observation and photo recording
2. To find out the goal to develop those shophouses in the urban context of Danang in 2050	- Importance of the neighbourhood to the city in 2050 - The goal to be reached for shophouses in terms of spatial organization	- Relevant books, research and articles - LOTUS[2] Residence and LOTUS BIO	- Desk review
3. To find out the possible approaches related to spatial organization for shophouses on	- Rationale to transfer green elements of Hoian ancient shophouses into shophouses on Hung Vuong Street	- Refer part 1 and 2 to figure out the answers - Data collection from shophouses on Hung Vuong Street and from	Mixed method: - Desk review - Observation, photo recording,

[1] Vietnam Electricity – the state-owned economic corporation of national electricity supply.
[2] The Green Building rating tools issued by Vietnam Green Building Council

Hung Vuong Street towards Green Building, referring from Hoian ancient shophouses	- Proposal for spatial organization of shophouses on Hung Vuong Street based on the references from Hoian ancient shophouses	discussions with their owners - Good practical examples found in the cities with similar conditions	and in-depth interview

2.2. Scope and limitation

2.2.1. Scope

When it comes to solve a question, probably, there would be more than only one answer. In the scope of this research, among different possible approaches, the solutions are mainly referenced from ancient architecture with the certain similar conditions. In other words, **the approaches for Danang shophouses should be referred from those in ancient Hoian**. Therefore, the research does not mention the solutions, those that are not deduced from Hoian old shophouses, even though they may be helpful to some extent.

Similarly, there would be several elements in architecture and Green Building that could be improved. However, since the research mostly focuses on spatial organization, it should not be expected to discuss other elements that are not relevant.

The research would mainly study on improvement the “resident” part rather than the “commercial” of the shophouses. It is because that it occupy a larger space than the shop, as well as the limitation of survey time does not allow the author to study all of shops in the studied area, which are fairly diverse in type and scale.

Moreover, the research does not discuss all shophouses in Danang in general, as well as on Hung Vuong Street in particular. **Only those located between Phan Chu Trinh and Trieu Nu Vuong were taken into account as the case study. Hence, the total number of researched shophouses is 86.**

6 households of them were interviewed. 4 out of them are both shop runners and homeowners. 1 is the shop runner who rents the space for his business, and 1 is the homeowner, who leases her first floor to a store.

2.2.2. Limitation

Due to the limited time to carry out the thesis, it would be unable to answer all questions to the fullest. Moreover, the research studies on shophouses, which are private spaces, so that the approach has faced a certain of difficulties. Rather than taking the great number of discussions, primary data were mostly collected from observation and some in-depth interview with the home and (or) the shop owners.

In addition, the research is lack of proper documents from the government. Even though in the recent years the city has been trying to upgrade their system on urban management, it has been dealt with some difficulties that some of the projects on data building, the GIS-application project, for example, have been stopped. Therefore, it not only takes time to analyse the current status of shophouses on Hung Vuong Street, but also it may lead to some unexpected misunderstandings caused by lacking of data.

The research does not grade the studied shophouses based on rating system, but figure out their challenges based on the system of objectives and different scenarios. It is because that the baseline model for shophouse is not an existing data. It should take time and efforts to collect data and build it up which have not been done so far within the scope of this qualitative research.

3. Literature review

For a comprehensive understanding, this chapter first discusses the used concepts in the study. Later on, “Green Building” and its elements are reviewed. From relevant documents, the green elements of Hoian ancient shophouses and the impacts on the development of shophouses on Hung Vuong Street, Da Nang are studied.

3.1. Definition

3.1.1. Shophouse

Shophouse is a house with additional function of a shop. The two different groups of activities, residence and commerce, combine into one building. Often shophouses are preferred to build on busy streets for enhance the purchasing power.

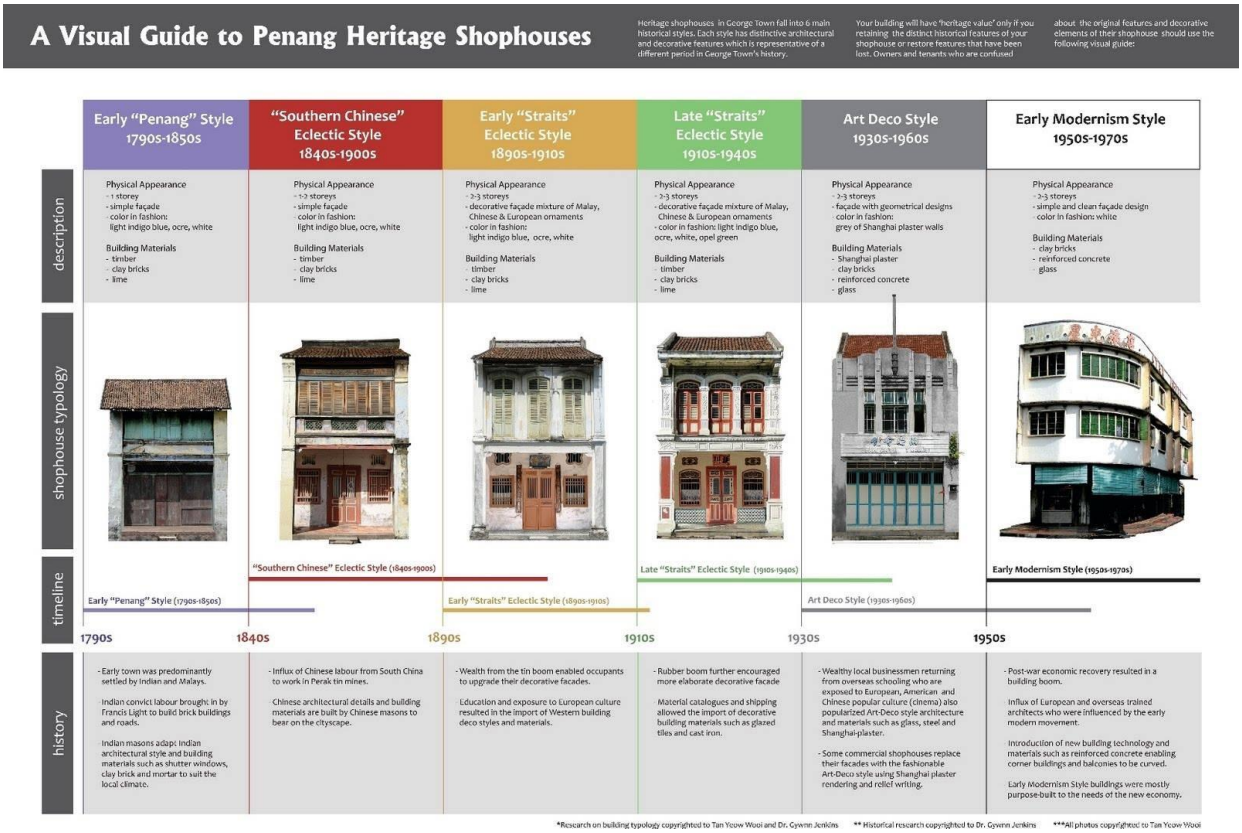

Figure 2. Penang heritage shophouses in Singapore, A2

Built in different parts of the world, shophouses are not all similar. Commonly in Southeast Asia, shophouse looks like a normal town house with a store on the ground floor and facades full of advertising products. They also have a long and interesting process of foundation and development throughout the history. Due to their historical value, a great part of them is still in well-preserved conditions in some countries. For instance, figure 2 shows the heritage shophouses in Singapore

those stay remaining since their first built in 1790s. According to URA[3], those row houses are small and narrow, and distance short from the street.

Among different types of multi-functioned house in Vietnam, shophouse is one of the most prevalent, not only in the current urban context but also throughout the history. They were found hundreds year ago, and some of them remain similar today.

3.1.2. Spatial organization

In architecture, spatial organization is the way a series of spaces are arranged into one recognizable whole (University of Oregon, 2015). There are often different spaces with distinct demands in a typical building program.

In relation to interaction between 2 spaces, they can communicate in a certain of ways. For instance, some of fundamental manners are described in the image below.

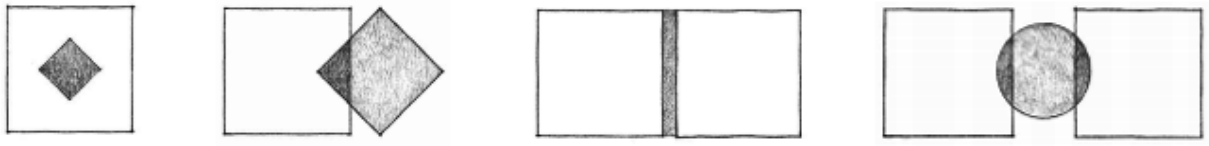

Figure 3. Spatial relationships between two spaces, A3

- Space within a space: the smaller space is contained within the larger one.
- Interlocking space: a part of the two spaces is overlapped.
- Adjacent space: two spaces borders.
- Spaces linked by a common space: one space in between connects the two other spaces. (Francis D. K. Ching, 2007)

In terms of relationship between a series of spaces, according to Francis D.K. Ching (2007), "The manner in which these spaces are arranged can clarify their relative importance and functional or symbolic role in the organization of a building. The decision as to what type of organization to use in a specific situation will depend on:

- Demands of the building program, such as functional proximities, dimensional requirements, hierarchical classification of spaces, and requirements for access, light, or view

[3] Urban Redevelopment Authority, Singapore

- Exterior conditions of the site that might limit the organization's form or growth, or that might encourage the organization to address certain features of its site and turn away from others" (p.194)

There are five types of spatial organization illustrated as follow. For each type above, the characteristics and the spatial relationships between spaces are different.

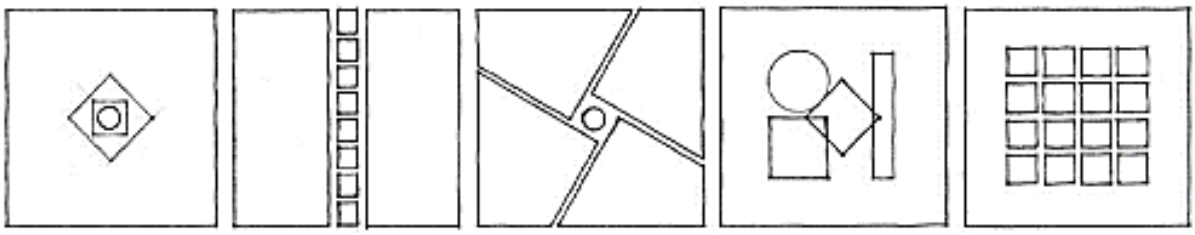

Figure 4. Types of spatial organization, A3

- Centralized Organization: A dominant space located in the centre and the secondary spaces are arranged surrounding
- Linear Organization: A series of spaces situated along a defined line
- Radial Organization: A combination of centralized and linear organization.
- Clustered Organization: The similarity in features or relationship group spaces.
- Grid Organization: The spaces are arranged following a grid. (Francis D. K. Ching, 2007)

In a house, space can be categorized into public – private, active – passive, served – servant[4] based on the tasks of the rooms. The relationship and hierarchy between them represent clearly through the spatial organization. This research mainly mentions about the category related to the served and servant spaces.

In architecture, spatial organization and program have a close relationship (Figure 5). Often the initial works of an architect is to study the demands of the building's users. By the knowledge, he or she first sketches the program (1) that indicates the functions and their interrelationships as well as the hierarchy order of spaces. Traffic is decided in this step. Second, after considering the surrounding conditions, the architect locates the functions at the fixed positions in responding to the site. Third, respecting to the dimension of the space, a grid is planned. Last, the specific structure and void-solid walls are decided. This general process is so called "transformation from program to schematic design". (Paul Laseau, 1980)

[4] According to Louis Kahn, served spaces are the main functional rooms, while servant spaces are those support the served spaces.

In this research, the process is implemented inversely. From reality, the functions and the relationship between them are deduced, based on the knowledge of the surrounding conditions and the users' needs.

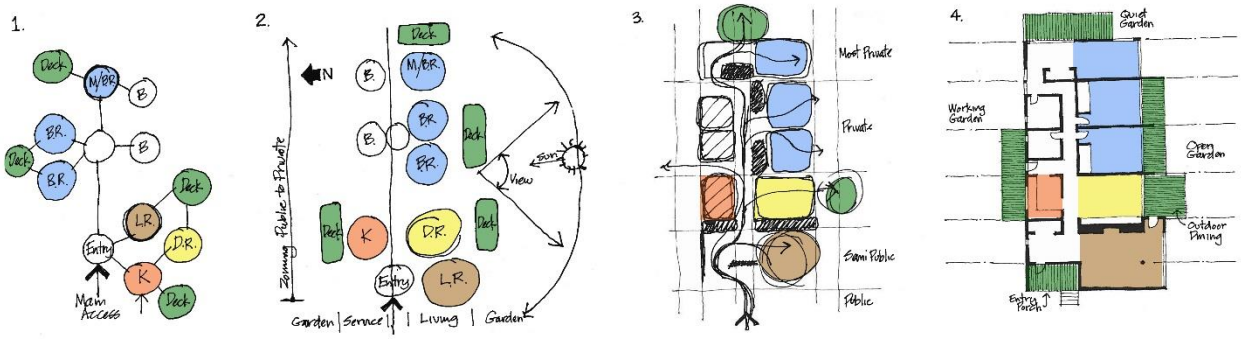

Figure 5. Transformation from program to schematic design, A4

3.2. "Green Building"

3.2.1. "Green Building" concepts

Generally, **Green Building** is defined as the building that handles natural resources in conscientious ways. Specifically, it should cause as small negative impacts on the environment as possible, require low energy supply, use renewable energy, use environmentally friendly materials, and operate economically.

However, as the concept is greatly paid attention the last decades, there are also several other definitions about the terms by different international organizations and architectural researchers.

According to USGBC[5], "Green building is a holistic concept that starts with the understanding that the built environment can have profound effects, both positive and negative, on the natural environment, as well as the people who inhabit buildings every day. Green building is an effort to amplify the positive and mitigate the negative of these effects throughout the entire life cycle of a building." (Jacob Kriss, 2014)

The Urban Land Institute defines that "Green building is the practice of increasing the efficiency with which buildings use resources — energy, water, and materials — while reducing building impacts on human health and the environment during the building's lifecycle, through better siting, design, construction, operation, maintenance, and removal."

[5] The US Green Building Council

Respecting to Bauer, Mösle, & Schwarz[6] (2010), "despite hampering nature as little as possible, (Green Building) can provide a comfortable living environment to meet the expectations of its inhabitants." (p.20)

Similarly, the VGBC[7] (2016) defines that "Green buildings are environmentally responsible, resource-efficient throughout their life-cycle and are designed, constructed and operated to reduce the overall impact of the built environment on human health and the natural environment by:

- Efficiently using energy, water, and other resources
- Protecting occupant health and improving employee productivity
- Reducing waste, pollution and environmental degradation"

Although there are several concepts defining Green Building, generally, they are all towards the benefits below. (Figure 6)

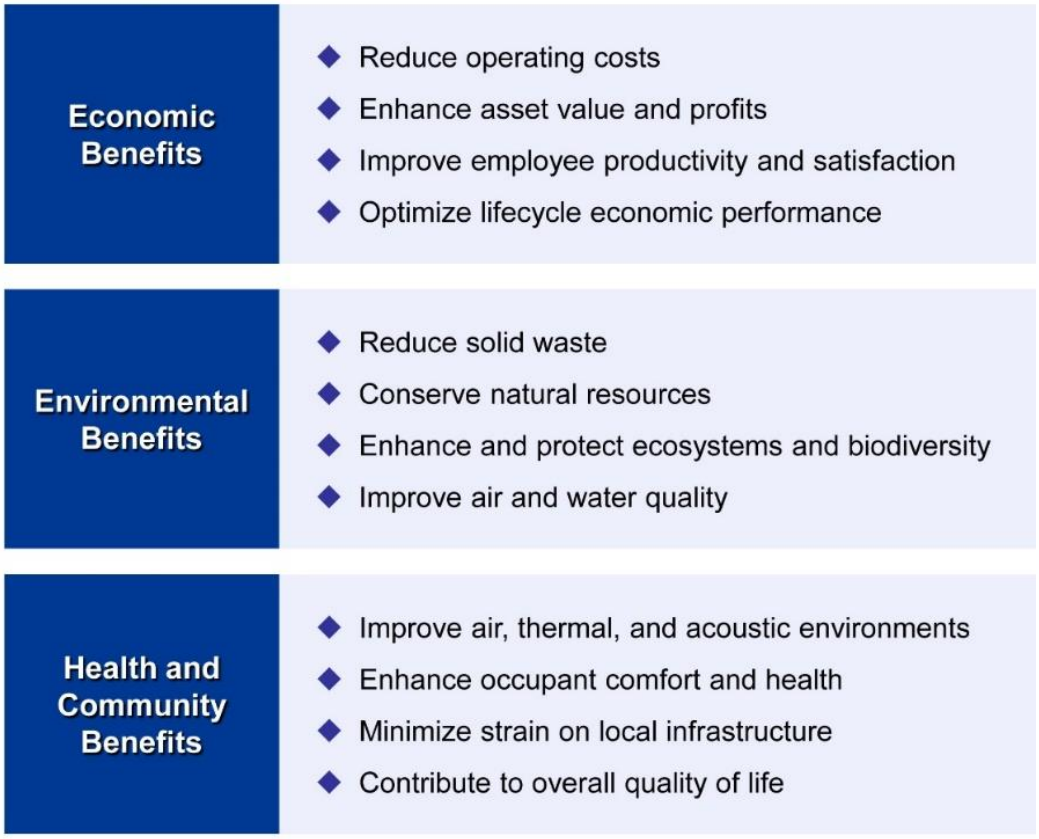

Figure 6. Benefits of Green Building, A5

[6] Green Building – Guidebook for Sustainable Architecture
[7] Vietnam Green Building Council

3.2.2. "Green Building" elements

Since the 20th century, there have been several Green Building councils established all over the world. Awareness of the importance of Green Building, those councils develop their own rating system based on the local conditions as well as international conditions. Currently, LEED[8], Green Star[9], BREEAM[10], BCA Green Mark [11]and many others are system generally used.

In 2013, there were on approximately 40 buildings received Green Building Certification in Vietnam. They are mainly in industry sectors, offices, as well as hospitality, and parts of them were certified under international Green Building Council such as USGBC, Green Star[12] and Green Mark, with some modification for adaptation (VGBC, 2013a). However, due to the need of a rating system based on the local conditions, VGBC has been developing LOTUS responding the unique circumstances of Vietnam, "with a great focus on climate change and mitigation". Since the tool applies similar benchmarks to other popular existing tools, it starts to be used more and more widely in the country. (Samantha Miller, 2015)

Although each rating system mentioned above has their own principles, criteria and ways of assessment, the general elements are similar to some extents.

Among current rating system for sustainable buildings, LOTUS is one of the latest that has been developed to "share the same goal of establishing standards and benchmarks to guide the local construction industry towards more efficient use of natural resources and more environmentally friendly practices." (VGBC, 2013b)

Issuing LOTUS, VGBC is in hope to contribute to the development of Green Building in Vietnam. Since LOTUS is built based on the local situation of Vietnam, this research is mainly referred to it for assessment Green Building.

Currently, LOTUS R is rating tool used for residential buildings. It is proper for new built or renovated houses that at least 70% of total floor area (excluded parking area) used for housing (Nguyen Tan Phat, 2015). Besides, houses operated from 18 months with the rate of using at least 50% can be rated also by LOTUS BIO, another rating tool issued by VGBC for operating buildings. Those two tools have similar categories that can be listed below.

[8] Leadership in Energy and Environmental Design (mainly in the US)
[9] National and voluntary rating system for buildings and communities by Australian Green Building Council (mainly in Australia)
[10] Environmental assessment method and rating system for master planning projects, infrastructure and buildings by Building Research Establishment (mainly in the UK)
[11] Launched by Building and Construction Authority of Singapore (mainly in Singapore)
[12] The sustainability rating system for buildings in Australia

- "**Energy (E)** – To monitor, manage and reduce the energy consumption of a building through use of energy efficient equipment, natural ventilation, renewable energy generation and energy management systems.
- **Water (W)** – To reduce the water consumption of a building through the use of water-efficient fixtures, rainwater harvesting, water reuse/ recycling and effective monitoring and management of water consumption.
- **Ecology (ECO)** – To protect the ecology of the building site and surrounding area, through management of the landscape and maximising biodiversity.
- **Waste and Pollution (WP)** – To reduce the quantity of waste produced during the operation of the building, as well as encourage extensive recycling practices.
- **Health and Comfort (H)** – To ensure high indoor environmental quality, through maximising daylight, external views and the monitoring and improvement of indoor air quality and occupant satisfaction.
- **Adaptation and Mitigation (A)** – To ensure the building reduces its impact on not only climate change itself, but also on the surrounding buildings and environment, while also being prepared for natural disasters and climate change related events.
- **Community (CY)** – To promote the social integration of a building within its neighbourhood, through public consultation, respect for cultural heritage and to facilitate access for persons and disabilities.
- **Management (MAN)** – To ensure that green targets are set and systems are in place so that occupants are aware of and can achieve these targets, as well as optimise the operation of the building to maximise efficiency.
- In addition to the above categories, an **"Innovation" (INN)** category rewards exceptional performance or initiative which are above or not specifically addressed by LOTUS." (p. 12-13)[13]

Among these categories, spatial organization more or less impacts on the certain items to some extents. Those items should be discussed later in Chapter 4.

3.3. Green elements of Hoian ancient shophouses

3.3.1. Overview of Hoian Old Town

Located 30km towards the south of Danang, Hoian is a small old town in Hoian city, Quang Nam Province (Figure 7). Similar to Danang, Hoian was found near a river outlet and once owned one of the most important ports during the 16th – 18th century.

[13] LOTUS BIO – LOTUS Buildings in Operation Pilot

Figure 7. Location of Hoian Old Town in Vietnam map, A6

Figure 8. Hoian Old Town from above, A7

According to Masumoto, the representation of Hoian Conservation Project, nowadays, no ancient town in Southeast Asia but Hoian has still retained the urban lifestyle and wooden-frame buildings that are almost similar to how they were in the past (Showa Women's University, 2006). Due to the outstanding universal values of Hoian, the town was recognised as a World Heritage by UNESCO in 1999.

Similar to the surrounding towns in the region, Hoian has an equable climate with typical weather phenomena of a tropical hot humid region which greatly effects on spatial planning and architecture of the town.

3.3.2. Historical urban context

The process of urban foundation and development of Hoian could be divided into 3 periods as below.

The surrounding area of Hoian was founded greatly long time ago with the remaining traces of Sa Huynh. Several antiques excavated in the quarter show that several busy commercial activities took place in town from the early AD. During the 2nd to the 15th century, under the reign of Cham King, Hoian was once a flourishing port due to its convenient location.

Since late 15th century, Viet residents started to settle in the fertile and favourable land Hoian. Nguyen Lord issued the policies allowing international trading in Hoian (Van Hoang Vo, 2015). Together with the Chinese, the Dutch and a part of Japanese community were the main

international traders in Faifo among different nationalities. Located along the historical trading route such as Maritime Silk Route (Figure 9), Hoian became one of the busiest sea port in Southeast Asia at the time (Waugh, n.d.). It was seen in the town the bustling merchant activities by traders from all over the word. Among them, due to interest on local products from Southeast countries, Japanese came for their business, got married to local women and built their home towards the East of the town around 1617 (Showa Women's University, 2006). Later on, the Chinese migrators developed the town towards the West and gradually surpassed the Japanese from the middle of 17th century. Tay Son war affected negatively on the town leading to the demolition of a great number of houses. Afterwards, under the governance of Nguyen dynasty, Hoian was continuously enlarged towards the South. From the middle of 19th century, the inactivity of the sea port due to topological difficulties and political decision of Minh Mang King ended the gloriously developed period of Hoian.

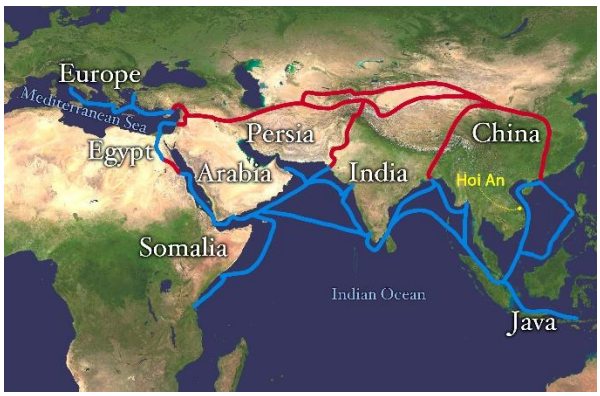

Figure 9. Hoian on Maritime Silk Route, A8

Figure 10. A voyage to Cochinchina in the years 1792 and 1793: Faifo, A9

It was not much changing on urban planning and architecture in Hoian old town from the time on. First, it is because that Hoian was not much damaged in the wars in the 19th - 20th century. Second, the massive urbanization commonly seen in Vietnam in the end of the 20th century did not much affect the town. Third, the preservation was carefully minded and implemented. The first studies on the old town were carried out in the 1920s, and from 1991, heritage conservation was organized with the great supports from Japanese government (Showa Women's University, 2006).

Shortly, through the long historical process, the remaining Hoian that people know today was found in the 16th century. The brief description of the important events and time in town are illustrated as below.

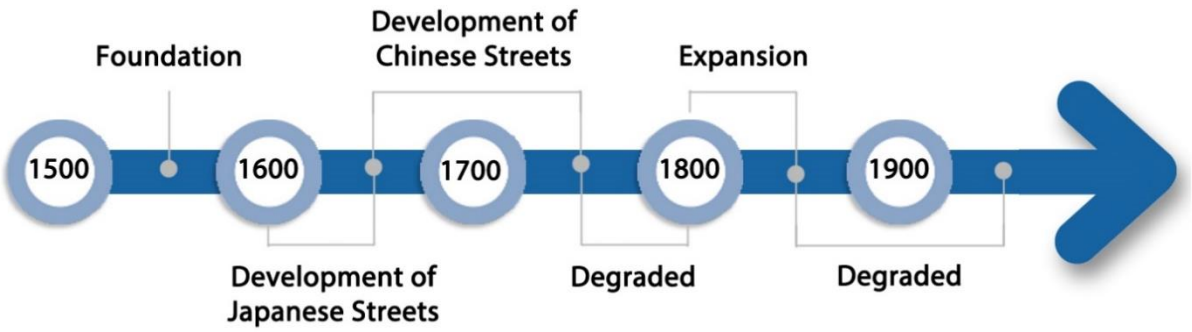

Figure 11. Timeline of important periods in Hoian urban foundation and development, A1

3.3.3. Current urban context

Today, Hoian ancient town remains several types of historical heritage including shophouses. The 3000-ha town was formed with grid streets running East-West and North-South. It is so-called "a living heritage town" since both tangible and intangible values still stay remaining. In other words, urban lifestyle of 3000 Hoian residents is almost similar with bustling trading activities and traditional festivals like its glorious past.

3.3.1. Green elements of Hoian ancient shophouses

Among different types of building remaining, shophouses are one of the most-seen in Hoian. Besides the high historical value greatly recognized by considerate preservation, the long life span of the houses is also originated from the livability of themselves. The elements have made the buildings livable are described below. Since the research mainly discusses on spatial organization, only relevant elements are mentioned.

Figure 12 shows **a typical neighbourhood** of shophouses in Hoian ancient town.

Located along the narrow long streets (7) are the main buildings (1). Often the main building has a deep overhang (8) that distances the house from the bustling street. Following the main buildings are a small building (2), a courtyard and a bridge building (3) connecting the front part of the house with the rear building (4). In the end of the lot (6), there is a backyard where located the kitchen, toilet and shower room.

In terms of urban planning, **the greenbelt** (9) is one of the most significant characteristics of Hoian Old Town. It has been created by a row of courtyards of the adjacent shophouses (UNESCO, 2008). In perspective of Green Building, the void space helps create a wind path, and hence, improve the microclimatic conditions of the neighbourhood.

Figure 12. Site context, A10

Generally, **a typical shophouse** in Hoian has 3 buildings as mentioned: the main building, the bridge building and the rear building (Figure 13).

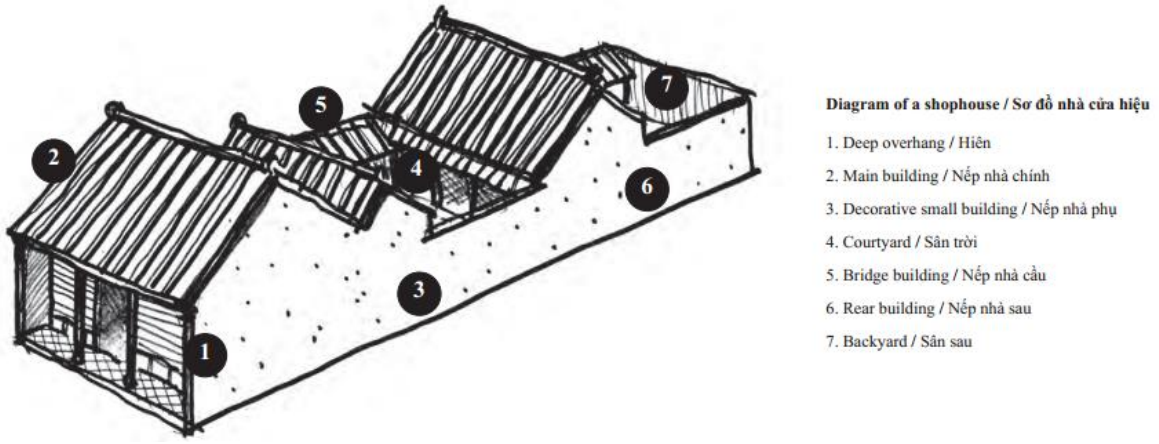

Figure 13. Diagram of a shophouse, A10

Each building has their own distinct functions. The main building (1) is in front of the house and used for trading activities. The bridge building (5) plays the role as the storage room for the shop. The rear building (6) is mainly used by the homeowners. The stone-paved courtyard (4) between the main building and rear building is furnished with a basin and plants. The backyard (7) is often smaller than the courtyard and mainly used by the homeowners.

By the spatial organization, the shophouses play well their residential and commercial function. Moreover, their operation also causes low impacts on the environment. Specifically, green elements related to spatial organization could be described in the following table.

Table 2. Green elements related to spatial organization of a typical Hoian ancient shophouse, T1

	Green elements	Physical features	Advantages
1	Urban spatial organization	The neighborhood is located nearby Hoai River and Hoian port	- To support the goods transportation to and from the shophouses
2	Building orientation	Houses were mainly built along the streets going the same direction with the river (East-West). In between, there are many small alleys running (North-West)	- To create a tight network of goods transportation - To create a wind path for breeze blowing throughout the neighborhood
		Some shophouses have the front facing to the main street and the back facing to river	- For better goods transportation - To get the direct river breeze blowing throughout the shophouses
3	Primary spatial organization	Shophouse is divided into 3 distinct spaces with different functions	- To ensure different demands of a multi-functioned building
		Those spaces are built continuously	- To ensure the operation of the houses in spite of changes in weather conditions

		Those spaces are connected via a hallway going throughout the house	- To create a wind path throughout the whole long house
4	Hierarchy order of spaces	Spaces are designed following orders of accessibility: first dynamic space, then still space; first public space, then private space, first served and then servant space	- To ensure the typical spatial order of a living space
5	Courtyard	The small patio in the middle of the long narrow plot; often has plants and basin	- To distance the spaces used for shop and house; to ensure the privacy of both users - To create a space for greenery; to enhance using of natural lighting and ventilation - To create the green belt for a wind path over the neighborhood
6	Backyard	The small patio in the end of the long narrow plot; often has plants	- To support demands of subordinate rooms such as kitchen, toilet and shower room. - To create a space for greenery; to enhance using of natural lighting and ventilation - To create another green belt for a wind path over the neighborhood
7	Deep overhang	At the front building of the house; like another span added to the main building	- To create a setback and to play as a transitional space for the shophouses

			- To avoid direct solar radiation as well as rainy crosswind
8	Balconies	For the first floor, looking down to the courtyard and the street in front of the house	- To open the view to the courtyard or the street for watching and breathing fresh air - To create another overhang for the spaces below
9	Storage room	In the bridging building and (or) on the mezzanine upstairs the shop	- To well connect the shop with its own store and make its operation not affect on other spaces of the homeowners.
10	Staircase	Often in the middle of the house and the location depends on the house's structure (for houses with a mezzanine in the main building, for 2-storey houses: in the bridging building, for houses with 2-storey rear building: in the rear building)	- To support goods storage or activities of the households in different situations
11	Flexible windows	Windows are assembled with a row of wooden planks and can be opened by taking out one by one plank	- To save space when opening the windows

Among the green elements listed above, some of them have been already applied in recent local architecture. However, in the case of shophouses on Hung Vuong Street, those elements should be carefully reconsidered based on the current situation of the neighbourhood.

3.4. Impacts on development of shophouses on Hung Vuong Street, Danang

Since the research wishes to develop the current situation of shophouses on Hung Vuong Street, the impacts on the development process of the neighborhood should be taken into account. By taking an overview on the city and the neighbourhood as well as description of the social-economic and the natural impacts, this part of the study should be referred to suggest possible proposals for developing the shophouses towards Green Building.

3.4.1. Overview on Hung Vuong Street, Danang

3.4.1.1. Danang

Figure 14. Location of Danang, A11

Figure 15. East-West Economic Corridor, A12

Located in the central, Danang is a coastal city having one of the most important ports of Vietnam. Moreover, its international airport is the major gateway to access Central Vietnam. It also has great advantages in traffic and transportation due to its location on the path of National Route 1A, North-South railway, and East-West Economic Corridor. Due to those strengths, Danang plays an important role in strategic national urban development. (Prime Minister, 2013)

Among the total natural land area of 1283.42 km2, 241.51 km2 belongs to urban districts (Danang Statistics Office, 2015). Danang is categorised as the first class city and a central municipality of Vietnam.

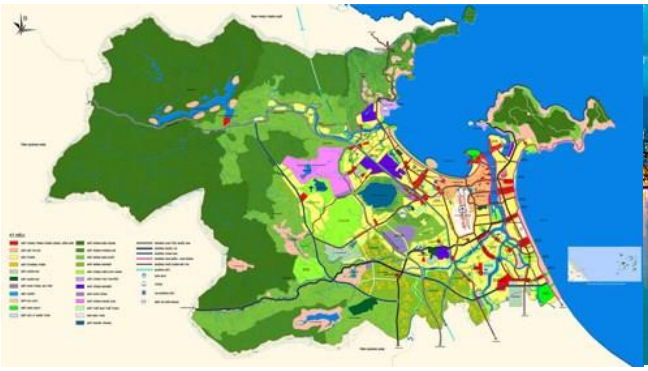

Figure 16. Danang's amended urban master plan, A13

Figure 17. The city centre, A14

Danang is the centre of culture, education, and technology of Central Region and Highlands of Vietnam. The latest growth of the city in those aspects attracts immigrants, hence, increases the population up to 1.029 million in 2015 (Thu Hoa, 2015). Among them, around 85% are reported to live in urban area, which makes Danang the city of highest urban population rate in Vietnam.

In relation to economic growth, the city has been fast recovered, increased industrial manufactory, enhanced domestic as well as international consumer, controlled inflation, and especially, issued new mechanism to improve the business environment that helps enterprises to develop significantly. (See table 3)

Table 3. GDP per capita and GDP growth rate, Danang, 2010-2014, T2

Year	2010	2011	2012	2013	2014
GDP/Capital (USD)	2016	2283	2294	2242	2487
GDP growth rate	12.6%	13.0%	9.1%	8.1%	9.28%

Danang has an equable climate with typical weather phenomena of a tropical hot humid region. Mountains and hills run towards the sea from the North-West and West varying city's terrain with several beautiful landscapes. Beaches, hills, and fountains are attractive spots for tourism.

Realising its advantages as well as receiving great supports from the government, the city has developed rapidly in recent years. Owning the highest PCI[14] in Vietnam for many years, Danang has invested actively in improving infrastructure, social secure, and environment. "Smart city", "Rapid Planning", and "Environmental City" are the most significant projects in sustainable urban development recently.

[14] PCI: Provincial Competitiveness Index

3.4.1.2. Hung Vuong Street

Situated in the heart of Danang, Hung Vuong is one of the busiest business streets in the city. The street goes 1.5 km long from Han River towards the West, through many markets and banks. The study area stretches 1km long and belongs to Hai Chau 1 Ward and Hai Chau 2 Ward, Hai Chau District. Han Market is located at the starting point, and Con Market is situated at the ending point of the case study. Since the bustling street goes along the two most important and old-established markets in the city, there gather several shophouses.

Figure 18. Location of the study area in the city, A15

3.4.2. History of foundation and development of shophouses on Hung Vuong Street, Danang

Founded in 192 AD, the region of Danang experienced a flourishing period with Sa Huynh culture. Presented by Cham King Jaya Simhavarman III in 1306, it became a part of the territory of Dai Viet (the former name of Vietnam). In the 16th century, while Hoian was one of two busiest commercial harbours of the country, Danang port played the role as an out port of Hoian, which was mainly used for transhipment and ship reparation. Soon afterwards, due to the development of shipbuilding technique in Europe in 17th and 18th century, the large vessels preferred to stay in the deep gulf, and Danang gradually replaced Hoian to be the major port in the central. Especially, after the edict of Minh Mang King in 1835, stating Danang was the only port allowed trading ships in the country, through the gateway to the world, the port town became much more bustling with trading activities associated with local handicrafts and shipping services.

The invasion and domination of France started in the mid-19th century after their first steps into Danang due to its important location in the territory. Renamed Tourane, the concession city was largely changed by the Western planners. Built mostly near the seaport on Han River, land was

divided into long narrow parcels going along grid streets (Figure 19). The city was also founded with supplement modern infrastructure and facilities such as airport, school and marketplaces. Tourane became such an interesting place for trading (Figure 20) that most of the largest companies in Indochina had their representative offices there. Markets and shophouses were popular places for goods purchasing and services. Those changes in French colonial period formed an important part of today city image. Nowadays, not only the fundamental facilities built by French still have been in use, but also the city centre is located in the same place and kept the similar urban layout.

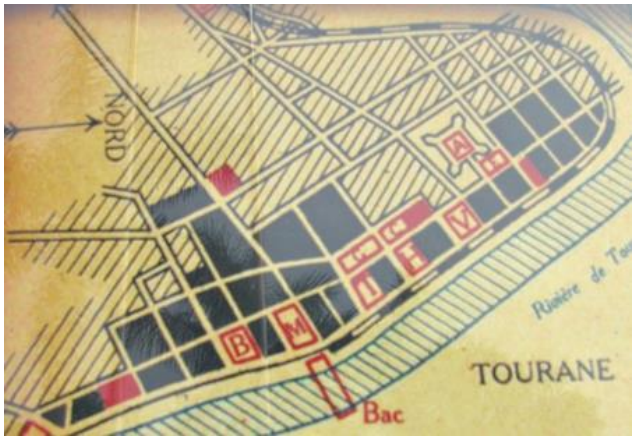

Figure 19. Planning of Tourane (1940) along Han River in French colonial period, A16

Figure 20. Life of the city along Han River in French colonial period, A16

In 1965, the United States army landed in Danang. Two years later, Danang was assigned as a central city by Vietnam Republic government and invested mainly for military support until **1975**, when the war ended. After the war, the city embarked on restoring its consequences. Economy was gradually recovered.

The year of 1986, when Vietnam implemented Doi Moi[15] Policy and marked another turning point. Economy was reformed to be more liberal; hence, trading was encouraged. Especially, in 1997, Danang was upgraded to the central city and later to the first-class city. Since then, Danang has had great funding from the state for urban development. **The year of 2000** marked a turning point of the whole city when the first bridge was built to connect its Western and Eastern parts. The city has achieved significant improvements in all aspects and keeps developing as the most important economic-social centre of the central of Vietnam.

[15] Renovation. Doi Moi was the period when the country set the goal to reach a socialist-oriented market economy.

Through the history of the city, it is obvious that shophouses on Hung Vuong Street have an interesting process of foundation and development, which greatly affected on the shophouse architecture of today.

3.4.3. Economic-social and natural impacts on shophouses development

Every building in the city would be affected by the surrounding environment it is located in. Shophouse is not an exception. Not only decided by the homeowners and the shop runners, the development of shophouses are also greatly affected by urban context and natural conditions of the surrounding area.

3.4.3.1. Economic-social impacts

- **Danang**

In relation to **building morphology**, the city history has a great effect on the land and building form. During the French colonial period, land were divided into long narrow plots, and the city planners have kept the way hitherto. Not only in the city centre, where the urban form largely stays the same as in the past, but also in the new-developed neighbours, it is common to see houses built high on narrow parcels. **A shophouse is first a house, so it carries the typical building form.** (Figure 21)

Figure 21. The typical building form of local houses and shophouses, A1

Since shophouses are houses with extra functions, **the regulations on housing management** are also applied to them. Currently, building permission is issued only when housing construction follows properly the latest approved detail planning 1/500 and regulations on redline depending on specific areas.

In terms of changes in **population**, there are more and more people living in Danang in the last years. Beside natural growth, mechanical population keeps increasing since the significant developments of Danang have highly attracted immigrants. Together with the great economic

growth, the higher population asks for higher demands and busier trading. Consequently, more and more homeowners of houses facing business streets, which have high renting value, have started to **lease their first floor and reform the living space within their upper floors.**

The growth of wealth in society and the new policies support business environment bursts the appearance of a great number of new enterprises in Danang. Moreover, as a trendy business making style in Vietnam, more and more start-up companies and shops are established, especially by the young. The dynamic city has its shophouses keeping growth in number, type and diversity of goods, which **effects on building form and architecture to some certain extent.** For example, recently, glass is largely preferred to use for shophouse façades, especially in the stores selling hi-end products.

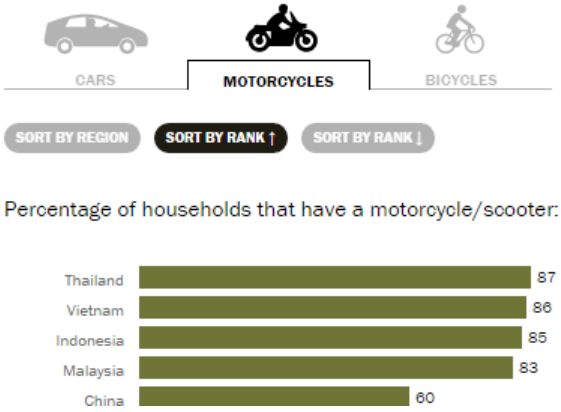

Figure 22. Percentage of households that have a motorcycle or scooter in different countries, A17

Figure 23. Traffic in rush hours on Hung Vuong Street, A1

The lifestyle of the city dwellers keeps shophouses developing despite some changes in society. Recently, together with some large supermarkets, there have been more shopping malls built in the city. The new places of goods selling lightly affect traditional business makers. However, the customers still prefer to buy daily foods at the traditional markets, as well as to buy other things from their familiar shops nearby the markets or on along the business streets. The purchasing habit is originated not only from the local culture but also from usual kind of transportation. According to Pewsearch Centre (Poushter, 2015), 86% of household in Vietnam own either a motorbike or a scooter (Figure 22). In other words, people prefer to use motorbikes in their daily life, and a host of them believe that it would be more convenient to stop the bikes by a shophouse for goods than taking time in the shopping centres (Figure 23). Therefore, in the current urban context with higher and higher consuming demand, the motorbike-dependent city still keeps opening **more retail stores, increasing the number of shophouses in the city.**

- **Hung Vuong Street**

Located in the city centre, the neighbourhood was found quite early in the urban developing process. A certain amount of houses in use today were built in the 1950s and 1960s. Supporting activities of the seaport as well as Han Market and Con Market nearby, houses were built up to three stories and normally used for both residential and commercial functions (Figure 24 and 25). **Old-establishment** is one of the most remarkable characteristics of shophouses in the study area.

Figure 24. Han Market before 1975, A18

Figure 25. Han Market and the neighbour shophouses (1960), A18

Owning a house on the most important business street in the city must always bring significant economic resource for the property's holder. It is common that the **homeowners are wealthy entrepreneurs**. Also in most of the case, they have been the shop runners on their own house.

In the past, often a successful businessperson owned several townhouses next to each other in a row. As a traditional way in the family, normally the properties pass down to the following generations after the owner passed away. It is common to see **that a great number of households on the street have been lived there for 60-70 years.** However, as life changes, the inherited children or grandchildren may continue to run the shop as before, expand or turn the business into another form of their own. Once the business changes, the house programming and structure may be also modified to fit the new requirements.

In some cases, the late owners even sell a part of the property to the others causing some **changes in housing programming**. Due to the division, both **new houses have small space.** In contrast, it is also common to see some **houses expanded** after doing business for years. Normally the wealthy showrunners buy the land plot and houses next to their own and renovate both buildings to have a united one.

However, as urbanization takes place rapidly in the last decades, the city expands out and reaches far from the city centre. There in the new neighbourhood, houses are much more spacious while

land purchasing price is much cheaper. For instance, while 1 m^2 in the studied neighbourhood costs 31.780.000 VND (around 1326 EUR), those in new built area 6 km away costs only around 2.000.000 VND (around 80 EUR) (Danang People Committee, 2014). Consequently, **several households moved out of the neighbourhood and saved the place for leasing.**

3.4.3.2. Natural impacts

- **Danang**

Among different elements from the physical building environment, those related to thermal, ventilation and typical weather phenomena are taken into account. Described data are referenced from Danang Statistical Yearbook 2014, the latest statistical yearbook up to the time of thesis writing, and from other related sources of document.

Month	J	F	M	A	M	J	J	A	S	O	N	D	Sum/Avg
Temperature (oC)	21.3	22.9	24.2	26.6	29.1	30.0	29.3	28.7	27.6	26.1	25.1	22.1	26.1
Hours of sunshine	97	163	168	199	267	230	240	209	164	135	116	68	171
Relative humidity (%)	84	84	83	83	77	73	75	77	84	85	87	85	81.4
Precipitation (mm)	82	16	18	22	31	66	121	182	485	601	623	177	2424

Figure 26. Monthly average temperature, hours of sunshine, humidity, and precipitation in Danang (2010 - 2014), A19

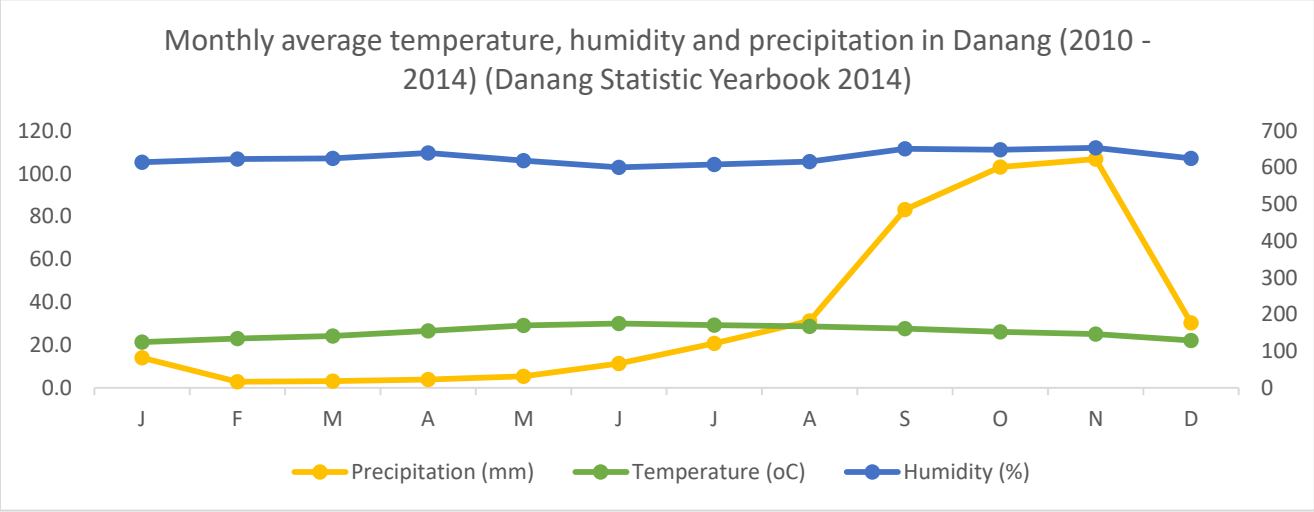

Figure 27. Monthly average temperature, humidity and precipitation in Danang (2010 - 2014), A19

Danang is a typical city located in a hot-humid tropical zone.

Over the course of a year in the period of 2010 – 2014, the average temperature kept as high as 26.1°C. There were not much changes in thermal fluctuation throughout the year. June was the warmest month with the temperature recorded up to 30.0°C.

Accordingly, the length of the day was also fairly high, up to 171 hours per month. The hours of sunshine varied from 68 in December to 267 in May.

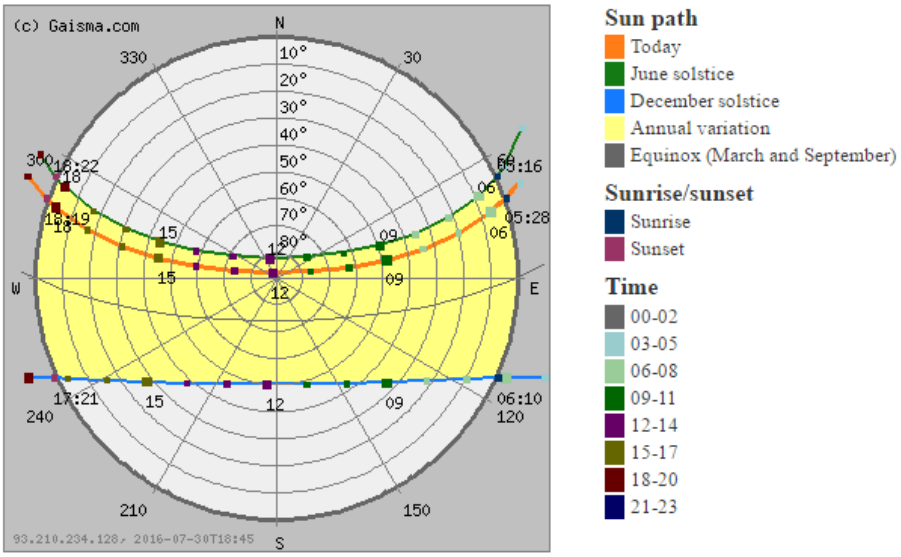

Figure 28. Sun path diagram, Danang, A20

The relative humidity stayed high, around 81.4%. Similar to temperature, it was rarely seen the wide fluctuation in the local humidity.

In contrast, the amount of precipitation greatly changed during the year. It is seen the hardest rain in November with the total number of 623mm for a month.

Briefly, **the high temperature and humidity throughout the year are two major challenges of buildings towards Green Building. For energy efficiency, it is simply crucial to shade the living spaces to avoid heating as well as using the appropriate materials for the building shelters.**

According to the local wind rose, the city has East-Southeast wind from the East Sea as its main wind direction (Figure 29). In the warmest days of the year, South-West wind from Laos has quite low humidity making the atmosphere less comfortable (Figure 30). On the other hand, wind from North and South of Northeast blowing in the winter cooler air down (Figure 31). **In order to get the highest efficiency in energy using, building form and orientation should consider winds from these directions and their characteristics as well as the coming time in the year.**

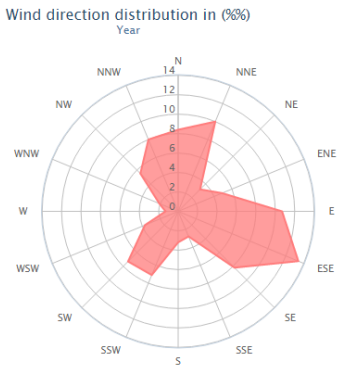

Figure 29. Annual wind rose recorded at Danang International Airport, A21

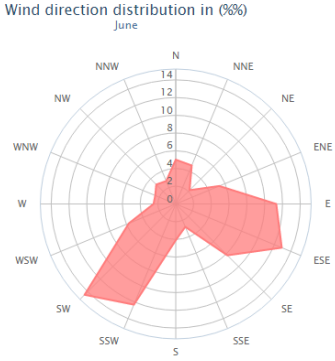

Figure 30. Wind rose recorded at Danang International Airport in June, A21

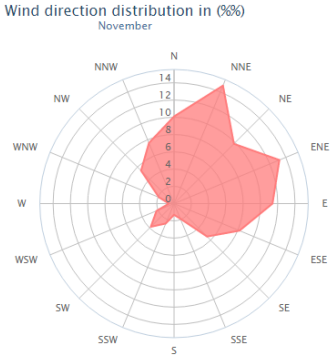

Figure 31. Wind rose recorded at Danang International Airport in November, A21

Tropical typhoon and flooding are common weather phenomena in Danang. In the period 2010-2015, there were 1136.73 billion VND (about 45.78 million EUR) lost due to them. More than 7000 houses were damaged by typhoons in 2013 (Danang Department of Agriculture and Rural Development, 2016). It is fairly common to see negative effects of the natural disasters on local buildings' roofs and glass façades. **Therefore, it is important to construct buildings with durable materials in the proper ways.**

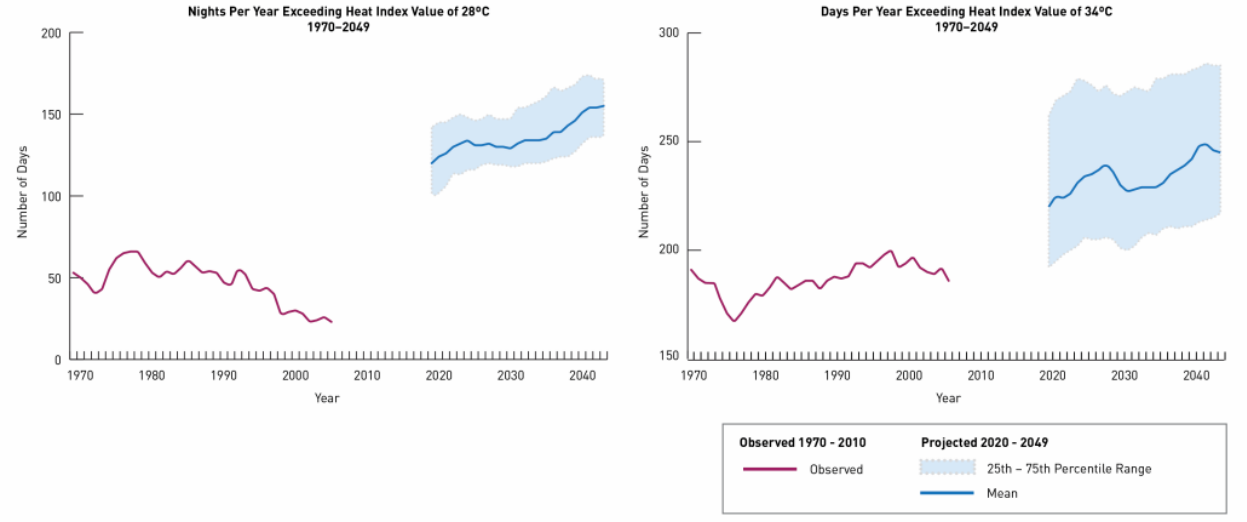

Figure 32. Changes in the number of nights (left figure) and days (right figure) per year in which the heat index exceeds the critical thresholds of 28°C (night), A22

Remarkably, **Urban Heating Island and Climate Change** has been affecting Danang in the last decades. In the period of 1970 – 2011, for every decade, there are 5 more days having average temperature surpassing 34°C. That means the total number of very hot days in town is rising faster

than the overall thermal increasing process. Also, the daily temperature of the hottest day gets 0.1°C higher per decade. In the period 2020 – 2049, from May to September, the heat index in the day time keeps high above 40°C affecting negatively to people working even in the indoor environment (Sarah Optiz-Stapleton, 2014) (Figure 32). As a result, the warmer the weather is, the more air conditioners are assembled. The more air conditioners are in use, the worse UHI takes place. Consequently, the cycle turns into one of the most difficult questions to answer for new built, in order to create a thermal comfort living environment for the citizens.

- **Hung Vuong Street**

Besides the general impacts mentioned above, there are some other features respecting the location of the neighbourhood.

Starting from Han River towards the West and located not too far from the beach, the neighbourhood has great advantages in natural ventilation (Figure 33). In the daytime, as the land's surface gets heated up faster than the water body in the river and the sea, there would be offshore wind blowing from the sea and the river to the land. Meanwhile, in the night time, since the water body cools off more slowly than the land's surface, sea breeze flows following the opposite direction. In other words, if there is no onshore wind as seasonal regime strong enough to oppose them, the neighbourhood will have airflows following East and Northwest pathway. However, winds from and to the East must be much more affect the study area rather than those from the Northwest because the street starts right from the river creating a **wind path going through the neighbourhood.**

Figure 33. Location of the study area in Danang map, A23

To some extent, the sea breeze helps cooling down the air and surface temperature inland. Thermal comfort, therefore, is more or less improved. However, it depends on the specific situations.

Urban Heating Island (UHI) also affects the neighbourhood greater than the other parts of the city. Since it is located in the densest area in town, there are more and more buildings, roads, motorbikes, cars and especially air conditioners surrounding. They trap heat and increase the average temperature making it harder to get thermal comfort, particularly in the context of the global climate change.

Chapter conclusion

The definitions, reviewed concepts, as well as the related data on Hoian and Danang shophouses were collected from the relevant books, articles, and documents from the authority. The data are in hope to provide the foundation information to approach the questions, and hence, they could be the base for finding the answers in the following chapters.

4. Spatial organization of shophouses on Hung Vuong Street, Danang

Regarding from literature review, Hung Vuong Street is one of the typical business streets in Danang city. In addition, due to its long interesting history, shophouses in the neighbourhood are quite diverse in ages and building form. In order to have a comprehensive understanding of them, the chapter describes the overall characteristics of the studied shophouses, their spatial organization as well as its impacts on the other elements related to Green Building development.

4.1. Overview of the studied shophouses

The studied neighbourhood is on Hung Vuong Street, located in between Phan Chau Trinh and Trieu Nu Vuong Street, Hai Chau District. Among over 100 buildings constructed, there are 86 shophouses in total. They are illustrated in orange in Figure 34.

Figure 34. Plan of the studied shophouses, A1

Currently, there are 3.7 settlers in each house, according to statistics from the local government. However, as there are many others living in the neighbourhood without registration, and some people do not really stay there but still register for personal reasons, the actual number is expected to be much different. Particularly in the dormitory at Hung Vuong 57, there are 5 families living on 5 different floors of the house.

Since spatial organization affected by several factors, in this part of the research, those related to land plot and building form are outlined for a concrete understanding of the current situation of shophouses on Hung Vuong Street as well as their spatial organization.

4.1.1. Land plot features

Due to the land plot division inherited from the French colonial period (See 3.4.3), most of houses, as well as shophouses, are built on limited-wide slots. Due to the plot form that is fairly long and narrow, the so-called “tube-house” has a hallway running throughout the whole building and

connecting all the rooms. The hallway looks like a tube, and plays the role of a mobile route. This feature names the building.

“Tube-house” is the typical form of house commonly found in Vietnam. Those on Hung Vuong Street are not the extension. According to documents from Office of Land Use Rights Registration of Hai Chau District (2016), usually the land plot in this area is 25 – 30m long and 5m wide. For every 100m, there is a gap left in between the two buildings next to each other for the drainage system.

In the studied area, the block in between Trieu Nu Vuong and Ngo Gia Tu Street (the top left block in Figure 34) has longer land plots. Those facing northwest and southeast are 30m and 35m in length respectively. Meanwhile, the 2 remaining blocks have a slight difference in length, ranging from 10m to approximately 35m. The most common length in those 2 blocks is 25m.

4.1.2. Current relevant regulations on building form

Also related to land plot, detail of public right of way, the minimum setback and the maximum extension of balconies are regulated in the Decision 9607/QD-UBND and Decision 9913/QD-UBND (Danang People Committee, 2010). They are illustrated in Figure 35.

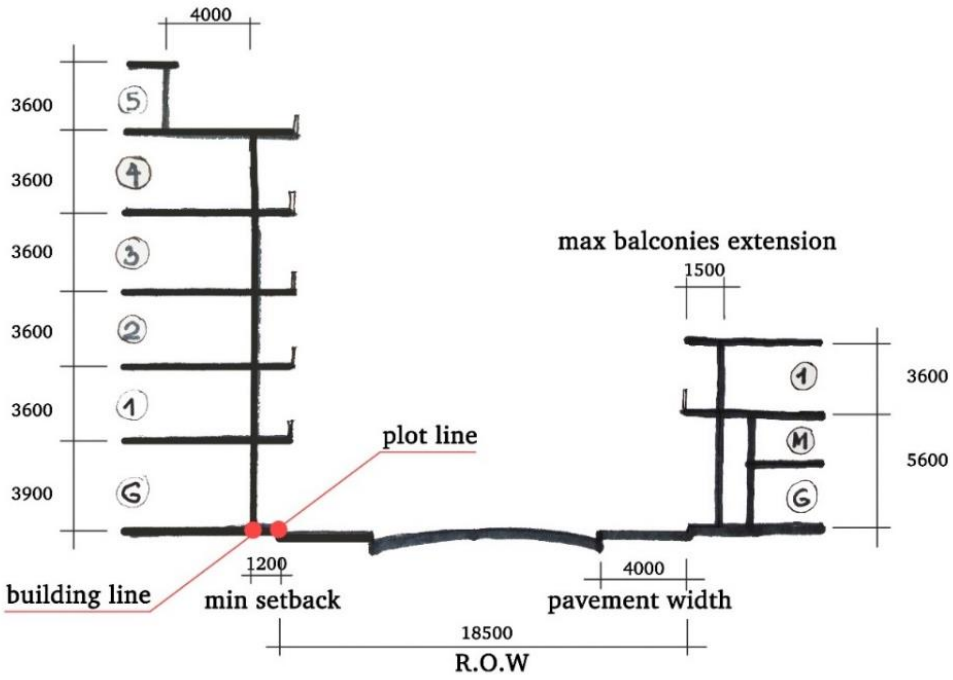

Figure 35. Illustrated section of Hung Vuong shophouses following regulations on Urban Management, A1

Today, the neighbourhood is strictly managed by the government. In order to improve the urban image, there are some regulations set on urban design, especially on building height. According to Urban Management Room of Hai Chau District (2016), the highest floor level is limited as 6 and must have a setback of 4m from the building line. For the new built, the height of the ground floor with and without mezzanine and the upper floor(s) must be 5.6m, 3.9m, and 3.6m respectively.

4.1.3. Categories of the studied shophouses

For a better understanding of the current situation of the neighbourhood, the studied shophouses are categorised into groups based on their building form and quality.

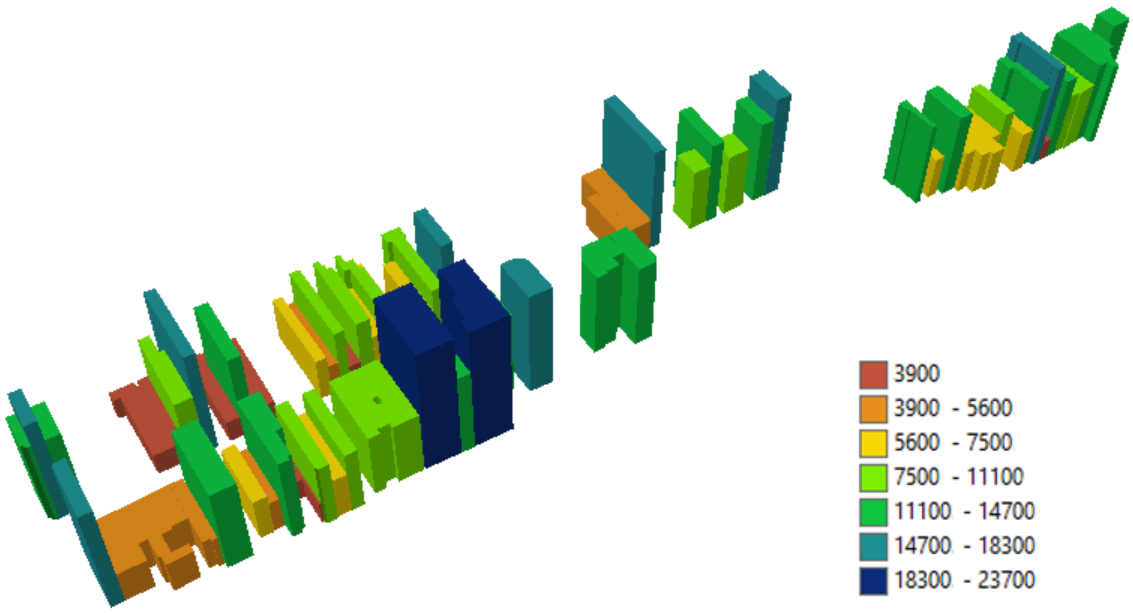

Figure 36. Illustration of building height in the neighbourhood, A1

Figure 36 illustrates the variety of building height of shophouses in the surveyed area. According to the status quo, the studied houses can be grouped as the following table.

Table 4. Building height of the studied shophouses, T1

	1-storey		2-storey	3-storey	4-storey	5-storey	6-storey	Total
	W.O.M	W.M	W.O.M	W.O.M	W.O.M	W.O.M	W.O.M	
Quantity	8	12	15	19	21	9	2	86
Percentage	9.3%	14.0%	17.4%	22.1%	24.4%	10.5%	2.3%	100%

As deduced from observation and photo taking, building height is varying from one floor with one mezzanine to six floors. Currently, in the neighbourhood, shophouses are preferred to be built up to 3-4 floors. 6-storey houses, the highest houses allowed, are quite rare. Among 20 1-storey houses, there are more than 50% having mezzanines.

On the other hand, houses can be grouped based on differences in building quality, which is mainly assessed by their appearance. Normally, the older buildings are, the more downgrading they are. Building ages are defined based one the architectural style, which is affected greatly by social features at the construction time. Referring from 3.4.2., milestones are set. For the **first period**, most of the existing houses were built in the 1950s and 1960s. They have 1-2 floors. Those constructed in the **second period** have 2-3 floors. In the **remaining period**, houses were built with 3-6 floors.

The difference in construction time also comes with different choices in the used materials. The remarkable changes through time can be seen on the roofs and the shelters. Ceramic tiles mostly roofed houses of the first period. In the following period, there were some houses roofed their top by tole and concrete, while the others still used ceramic tiles. Recently, house owners seem to prefer roofing totally by tole. The shelters are also made new with **the appearance of glass and aluminum on the facades** in the last years. However, as the result is deducted from only observation, the building age of some houses cannot be defined their age because it is not obvious from the look. Figure 37 shows the typical shophouses with different architectural styles mentioned above.

Figure 37. Phung Ky - built in 1950s, Minh Tam - built in late 20th, and Thuy Bich - renovated in 2010, A1

Figure 38. A degrading shophouse (top left), A1

Most of the houses in the studied area are in good conditions. Except some houses without good maintenance have been degraded that negatively effects on living comfort of people in the houses

(Figure 38). Especially, the dormitory at Hung Vuong 57[16], which was built before 1975, has been renovated spontaneously. The building quality is not more than 40%, and it has the high risk of being collapsed and fired. Soon it would be acquired by the government. (Viet Hung, 2016)

4.2. Typical programming and spatial organization

Although houses are categorised into different groups, the general programming as well as spatial organization of the house still stay similar.

As described above, the inner spaces in a typical "tube-house" are connected through a narrow hallway. Therefore, the shophouses on Hung Vuong Street have typical features of **linear spatial organization** (See 3.1.2). The programming and spatial organization are described following the accessing order from that entrance (Figure 39).

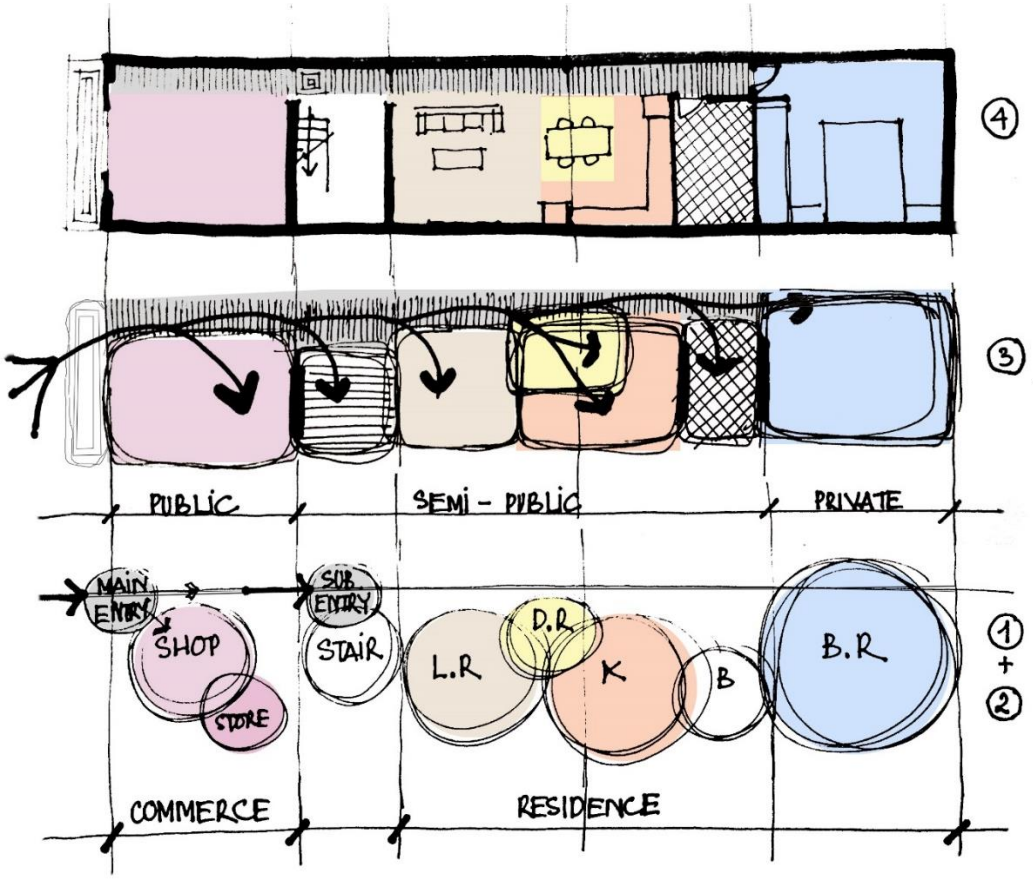

Figure 39. Transformation from schematic design to programming, A1

[16] This house has a special floor plan that is totally different from the remaining. 2 households live on 1 floor and access to their houses by a staircase in the middle of the building.

Those houses often have only one entrance from the main road shared by the homeowners and the shop runners.

Due to the high requirements of accessibility, the commercial spaces are always located in the front of the house. A major of shops have two main rooms in use: store and storage. The store is often flexibly divided into spaces for showroom, cashier and advisory, technical works and possibly fitting rooms in some cloth shops. The storage is either separated in another room or combined into the store within shelves and cabinets (Figure 40 and 41). The shop runners usually occupy from a part to the whole of the ground floor. Some shops even use up to the area of the upper floors.

Figure 40. Showroom, cashier, technical works, storage combined into one space in a shop, A1

Figure 41. A separated storage located on the upper floor of a store, A1

The remaining spaces in the house are used for residential function.

Generally, the served and servant spaces have a fairly clear separation in terms of accessible order. The served spaces are always the prior, either closer to the entrance and hallway or located on the lower floors.

The served spaces of the homeowners and their family are programmed into living room, dining room, kitchen and bedroom(s). Kitchen and dining room are often combined in one space (Figure 42), and in some houses, they are mixed with living room creating a large shared space. In houses that have more than one storey, bedrooms are often upstairs.

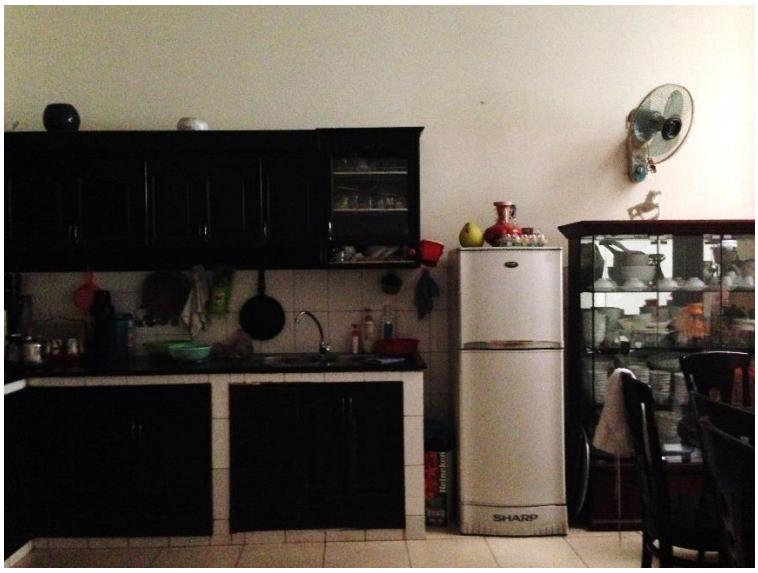

Figure 42. The shared space of kitchen and dining room in a shophouse, A1

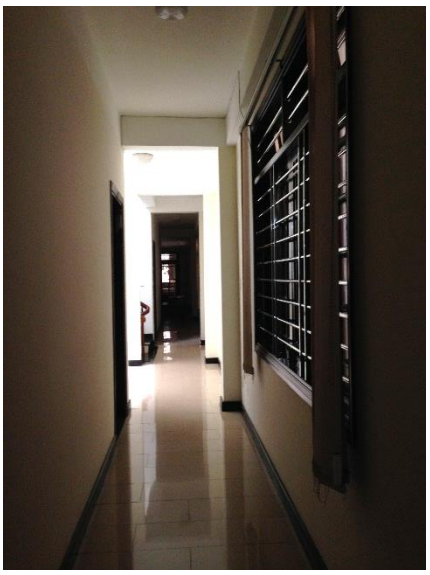

Figure 43. The hallway connecting rooms in a "tube-house", A1

The servant spaces in a private tube-house are hallway, staircase, bathroom (s), parking area, greenery, storage and mechanical spaces.

According to the relationship between the rooms of a house (Figure 44), it is common to see that hallway is the connecting space. Therefore, it runs throughout the length of the building (Figure 43). Besides linking tasks, hallway also plays a vital role as a wind path.

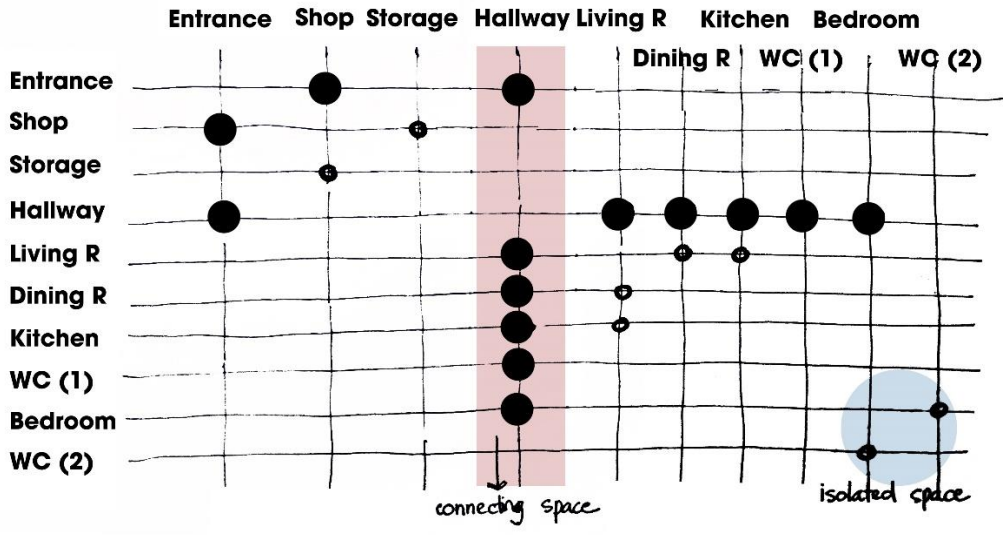

Figure 44. Relationship between typical rooms in a shophouse, A1

Located in the middle of the house, staircase is preferred to be built next to the living room. Some houses have more than one staircase (see figure 45). In shophouses, it plays the role of a conventional space separating different rooms such as commercial – residential and public – private. In some houses, staircase is combined with atrium and has an opening or transparent roofing (Figure 46). Therefore, in some cases, rooms located next to staircase can use natural light by opening window(s) into that space.

Bathrooms are on every floor of the house. Normally those on the ground floor are shared by the shop runners, homeowners, and their guests. On the other hand, those from the first floor are more private and isolated (Figure 44). Some of them are designed for personal uses and often accessible only from the nearby bedrooms.

Figure 45. A shophouse on Hung Vuong Street with 2 staircases, A1

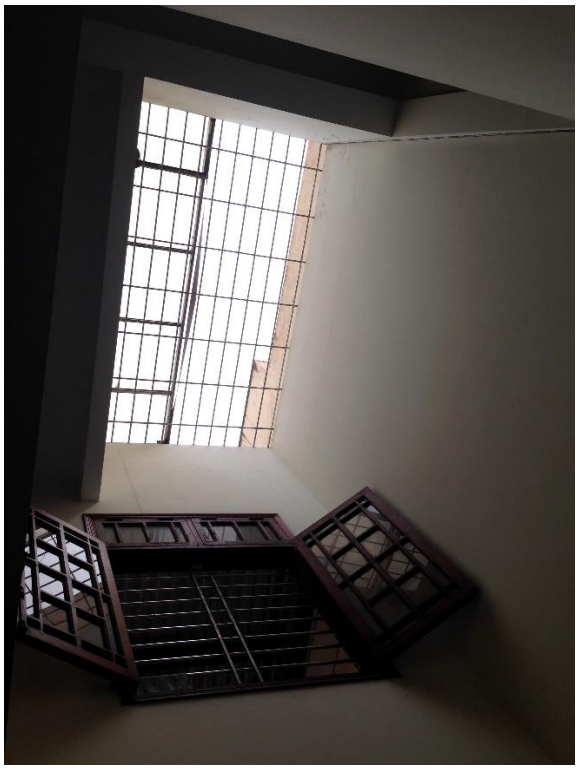

Figure 46. Atrium of a shophouse on Hung Vuong Street, A1

Parking area for motorbikes of homeowners, shop runners, staff and visiting guests are organized on the pavement during the opening time of the store. Some rarely used bikes are kept in the following room behind the shop. In the night time, after the closing the store, all bikes are parked inside. For houses without parking room inside, it is common to see bikes taking space of the store or the living room.

Greenery is fairly rare in townhouses. In houses with some green area, often they are planted in the atrium, balconies and on the rooftop terrace. Recently, there are more and more households starting to have their own vegetables collected from the garden.

Not all houses have separated room only for storage. Used furniture is often kept on the highest floor in the space rarely reached.

In relation to mechanical spaces, while new-built houses hide their pipes beneath the walls and floors, in the old ones, electrical wires and gas pipes are apparent to the eyes. However, the systems are not complicated. Electricity is used for lighting, housing electric appliances, computational and mobile devices and water heaters. A major of families cook with gas, and some households start to use the electrical kitchen utensils as the supplement, not the replacement.

Currently, there is no litter separation system in private houses in Vietnam. Wastes are collected from different rooms in the house, left in front of the house and carried away almost every day. Therefore, there is no considerable space required for litter separation. Recycle waste such as glass bottle and old paper are saved in the kitchen or in a separated room in some houses for later selling to the street vendor purchasers.

Particularly, often on the highest floor of some houses, the altar is organised in a separated room so-called "**altar room**" facing the main street. The area of the room depends on several factors. Among them, the worshiping frequency of the household is probably the most decisive one.

4.3. Consequences of spatial organization of shophouses in perspective of Green Building

Even though the current spatial organization fulfils the needs of a shophouse in the basic level, there are some issues should be discussed for some elements to be improved. They included matters related to general programming, building rate, building form, and shelter.

In terms of **programming**, although the hierarchy of spaces are well considered in almost of the studied shophouses, their dimension are not yet proper. In multi-functioned buildings like shophouses, the separation into two spaces of shop and house may cause some conflicts due to their completely different functions and characteristics. For instance, noise from trading activities needs to be blocked from the living space. It is necessary to have a space in between for insulating these 2 different needs.

Living in the dense urban area, people often wish to maximise the building form due to the high demand in use. Because of the long narrow land plot, building up to several floors is preferred. This circumstance of high **building rate** causes some challenges for the houses.

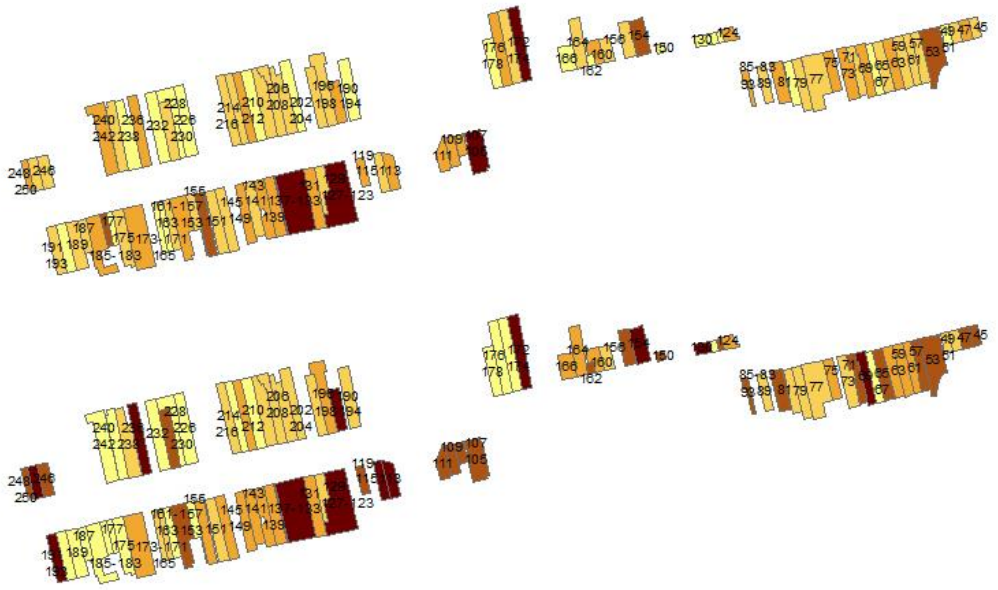

Figure 47. Illustration of building height (top) and energy consumption (bottom), A1

First of all, the bigger the house is, the more energy it consumes. According to documents from EVN[17], the amount of energy consumption in the last 12 months (October 2015 to September 2016) of shophouses in the neighbourhood were collected and illustrated in figure 47. To some extents, the figure shows the positive correlation between building height and energy consumption.

Secondly, it is quite common to see people turn on light in their houses even in sunny days. It is because that building rate is too high for natural lighting ray to have void space to go through. Consequently, energy is always consumed for lighting despite the weather. Aeration in house is also limited. Figure 47 shows an example of the daily air flow in a typical shophouse. Air goes from the always-opening shophouse entrance to the opening roof and the back terrace. The bedrooms in the back, bathrooms, and even living room are isolated.

Finally, by maximising the built-up floor for use, the unsealing area is quite rare. Greenery is rarely found in those houses.

In relation to **building form and shelter**, due to the typical features of a "tube-house", each house has their front and back towards the outdoor space. However, for demands of the shop, the front façade of recently built houses is often occupied by advertising products (Level 1, Figure 47). The roof, which is so-called "the fifth façade", is also almost covered keeping the inner space insulated from the outer space. These characteristics of spatial organization limit natural lighting and ventilation.

[17] Electricity Vietnam

Chapter conclusion

The studied shophouses on Hung Vuong Street are built similarly to a “tube-house”, the typical building form of townhouses on narrow long land plots in the cities of Vietnam. Following linear spatial organization, the hierarchy of spaces from the main and only entrance are clearly presented in the house. The current programming, as well as the spatial organization of the studied shophouses, generally meet the demands of the buildings. However, due to some limitation in building form and spatial organization, the houses have been facing some challenges that are in needs to consider and deal with in the process of developing them towards Green Building.

5. The goals to develop the studied shophouses in 2050

This chapter discusses the rationale to develop the studied shophouses on Hung Vuong Street as well as the goals that they are expected to reach in the near future of Danang.

Currently, the furthest milestone that the master plan of the city is the year of 2050. The most important projects that are relevant to urban development also have their vision of targets no later than 2050. In addition, resulting from 4.1.3, 87% of current shophouses in the studied area have 1 to 4 stories; hence, they are classified as Fourth and Third Class Building (Ministry of Construction, 2012). In other words, their lifespan is no longer than 50 years. Therefore, 2050 would be the expecting point of time to consider the possible improvements of those shophouses in the local urban context.

5.1. The role of shophouse development on Hung Vuong Street in Danang in 2050

5.1.1. Vision of Danang in 2050

Regarding the decision on adjusted master urban plan of Danang towards 2030 with a vision to 2050 (Prime Minister, 2013), Danang is expected to have a great number of strong moves in sustainable growth. “In the strategy for the near future, Danang aims to be sustainably developed towards an environmental and livable city as well as greatly attract large investors and economic corporations to do business in the city”, according to Danang UPI[18] (2013). In order to reach the targets, Danang has implemented some major projects related to urban development recently.

The project “Danang – The environmental city” was launched in 2008. From that time on, the city has accomplished the first two periods and gained some remarkable achievements. Among them, Danang was award the ASEAN ESC Awards[19] in 2011 for its efforts to keep the city clean, green and livable (Asia Cooperation on Environment, 2011). In the last period of 2016-2020 of the project, the city continues paying efforts on developing environment-friendliness (Ngo Huyen, 2012).

Additionally, in 2012, Danang was selected as an APEC city involving in the Low-Carbon Model Town Project (ILO Regional Office for Asia and the Pacific, 2012). The project pointed out recommendations in several aspects for the city to fulfill its green objectives. Among them, the concept of a compact town structure and Low-Carbon Building design are highly suggested to be considered (APEC, 2014). By cutting thousands tons of carbon emission, Danang is on the way to reach its target of becoming a “green city” in 2020 (VNS, 2013).

[18] Danang Urban Planning Institute, the descriptive document on the development of the city (Page 136)
[19] ASEAN Environmentally Sustainable Cities Awards

In 2013, Danang Sustainable City Development Project was run and disclosed by the World Bank. It is one of the largest projects implemented in the last decade. Its five components greatly improve urban metabolism in a sustainable way, and hence, help to city step further heading a livable city.

Briefly, although the city has been investing into several different projects at different time, **the major goals generally target at sustainable urban development**. Since Danang is one of the cities that much suffer negative effects from climate changes, these improvements are highly essential and proper to the current context of the city.

5.1.2. The role of shophouse development on Hung Vuong Street in Danang in 2050

In order to attain the proposed targets, Danang is gradually concretizing their strategies. The very first step of the action program is to partition the whole town into many zones with their own tasks to perform. Figure 48 shows the location of the studied area in the maps of partitioning orientation.

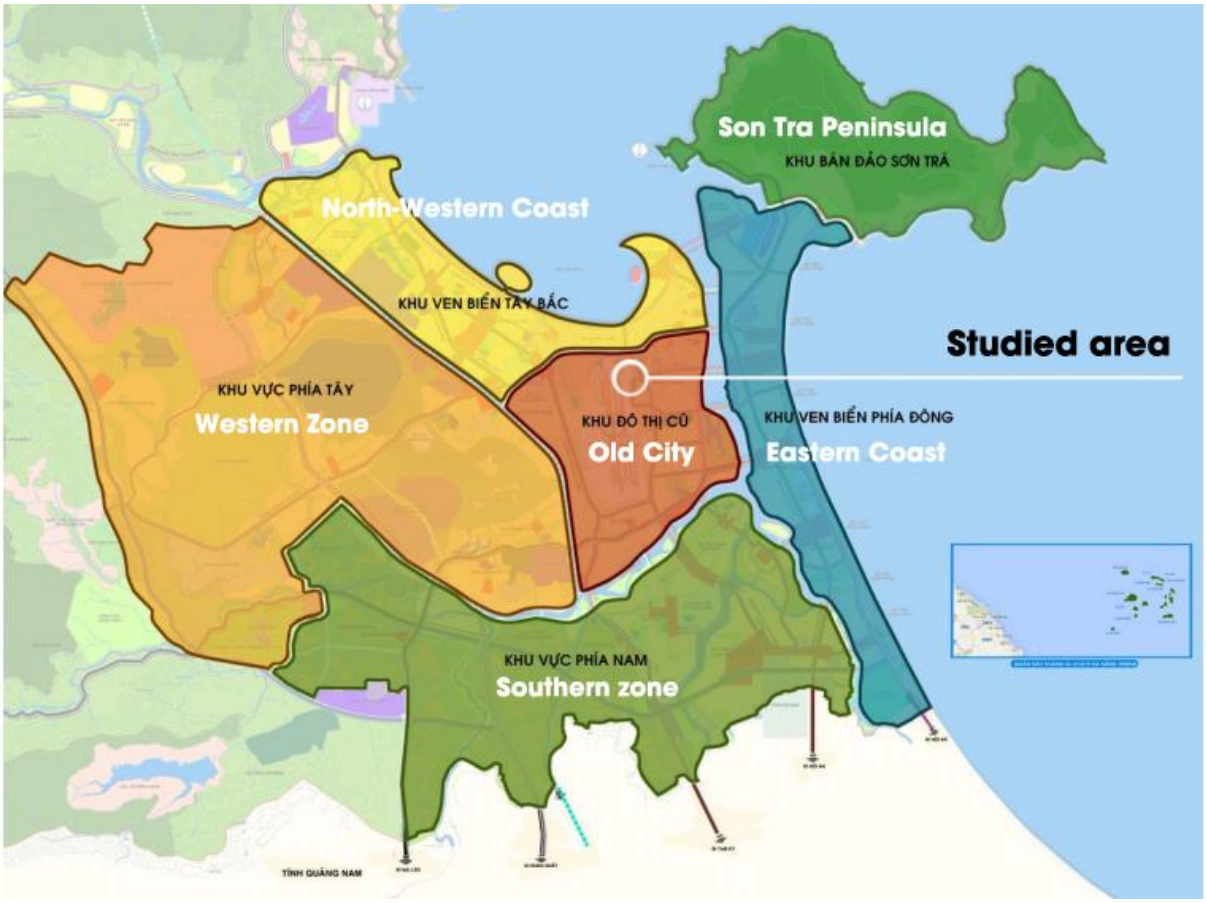

Figure 48. Orientation of partition in urban development, A25

Situated in the Old City zone, the surveyed neighbourhood is responsible for developing as a destination for shopping, in combination with the nearby comfort such as complex buildings for office, residence and commerce, markets and cultural parks along the river side. Due to the performing tasks, the shophouses are expected to well integrate with the other business centres in the city building a young dynamic town (Danang UPI, 2013).

Not similar to other new built parts of the city, the studied area is not expected to undergo great changes related to urban reform. However, it is in hope to be improved in infrastructure. One of the significant developments is associated with the city traffic system. As building the new BRT[20] system, there would be two bus lines with several stops designed on Hung Vuong Street connecting the neighbourhood with the other parts of the city (Danang BRT, 2016). This would enhance the traffic going through the neighbourhood and bring much more economic benefits to the shophouses in the area.

In the whole picture of city development, another critical contribution of the neighbourhood stays in its location. Situated in the heart of Danang, the area would directly affected by several important projects once they are implemented. The pilot walking street is one example. In the descriptive data of adjusted master urban plan of Danang towards 2030 with a vision to 2050, the concept was proposed to choose the studied area for attracting tourists as well as developing much more the shopping destination of the city (Danang UPI, 2013). Even though the concept has not been officially developed in any specific project, it shows that the area has a great potential to grow much more in the future.

Among several mentioned aspects for developing the Old City, Green Building is proposed as one of the significant considerations. A compact town is continued to develop due to the high density of the zone. Moreover, greenery is greatly paid attention. A series of green concepts are planning to apply to the area such as “Garden in the town, Vertical garden, and Roof garden”[21] (Danang UPI, 2013).

In brief, the development of the neighbourhood on Hung Vuong Street, in general, and the studied shophouses, in particular, play a vital role in the growth of the city. In order to perform well the given tasks in the most updated master urban plan, it is necessary to develop the neighbourhood with the comprehensive and integrated approaches. Among them, Green Building application is expected to be the effective tool for buildings and houses in the area, in hope that it could help the Danang move greatly towards a sustainable urban development.

[20] Bus Rapid Transit. The project is currently implemented and is estimated to finish in 2030. (Tan Viet, 2016)

[21] Danang Urban Planning Institute, the descriptive document on the development of the city (Page 192)

5.2. The goal of shophouse development on Hung Vuong Street in Danang in 2050

Realizing the importance of the shophouses in the studied area, **the local government has had a strong to develop them in a sustainable way**. Application of Green Building is also highly recommended to consider. However, how green a building should be at when has not been officially documented yet. Without a specific and reachable goal, it would be difficult to orientate those shophouses to develop in the expected way. Therefore, for a clear vision of the shophouses in the near future, this part of the research describes the goals for their development based on the current documents on the issues.

5.2.1. System of objectives

Referring to the role of the neighborhoods briefly mentioned above and the elements of LOTUS standard, a system of objectives is described below (Table 5). Among three issued rating tools in LOTUS system, LOTUS R and BIO are used. It is because that shophouse is categorized as a residential building, and the studied area is currently in use. These two rating tools have similar elements as introduced in 3.2.2.

Table 5. System of objectives, T1

OVERALL CONCEPT	**Shophouse development towards sustainable buildings; vision to 2050**		
SUPERIOR OBJECTIVES	**Ecological Aspect**	**Economic Aspect**	**Social Aspect**
	To limit the negative impacts of construction and operation on the environment	To use resources for construction and operation efficiently	To improve quality of living space and business environment
SUBORDINATE OBJECTIVES	**(ECO) Ecology**	**(E) Energy**	**(H) Health and Comfort**
	To protect the ecology of the building site and the surrounding area	To use energy used for lighting, cooling, and heating efficiently	To meet the minimum requirements of standard indoor living spaces in terms of health and comfort

	(WP) Waste and Pollution	**(W) Water**	**(CY) Community**
	To reduce waste and pollution discharged into the environment in its building lifecycle.	To reduce fresh water utilization	To encourage social integration of the buildings within their neighbourhood, maintain historical and cultural values, and ensure accessibility for disables.
	(A) Adaptation and Mitigation		**(MAN) Management**
	To reduce negative impacts on climate change and the surrounding environment; and to be prepare for natural disasters and climate change related phenomena		To ensure that stakeholders are aware of and can well perform their tasks

Among 9 elements included in LOTUS standard, there are 5 elements taken into account as the subordinate objectives for development. It is because that in the scale of the research, which is almost related to spatial organization and its relevant issues, the targets mentioned in **Water, Community, Management and Innovation** are out of reach.

Respectively, these 5 subordinate objectives have their own goal to reach in 2050.

(ECO) - Since the area is already a neighborhood for years, its ecological conditions could be improve by increasing the greenery area. Within the scale of a single building, it would be reachable to maximising the **green area** by several ways.

(W) - In the studied area, due to building's conditions and new demands, there would be renovation, demolition and new construction of some shophouses in the near future. To reduce waste and pollution emitted into the environment due to these activities as well as during their

operation, it is necessary to **optimize the existing area to adapt with different demands**. In case the buildings should undergo the inevitable renovation or new construction, re-use components are highly recommended. For later built shophouses, the **spatial organizatio**n should meet the demands of the buildings.

(A) - From the perspective of spatial organization, negative impacts on the environment and surrounding area could be reduced by several ways including **reduction of building volume where unnecessary, enhancement of green area, spatial arrangement based on the local weather and building orientation**. To cope with natural disaster in general and tropical typhoon in particular, **durability of house** should be highly well cared.

(E) - In order to use energy efficiently, natural lighting as well as reduction demands for cooling and heating should be taken into account as the priority solution. This could be done by **maximising the efficiency of spatial organization**.

(H) - In terms of health related conditions, **natural lighting and ventilation as well as external view are encouraged**, which could be well done by an appropriate spatial organization. In relation to living comfort, the conflicts between residential and commercial spaces should be reduced by insulation.

5.2.2. Discussion on the goals to be reached in 2050

It is visible to see in the recent projects, the city has paid a great effort to fulfill those objectives in the future. By 2050, there would be several scenarios to be foreseen. In this research, the scenarios are analyzed based on what have been done so far and what could be done in the near future.

There are about 35 years until 2050. Taking a look back on the last 35 years, it is not difficult to realize how the shophouses in the studied area have been developed. Among the changes, the building height is one of the most remarkable. Moreover, the living comfort has been much improved by the introduction of the new types of home appliances. Once supported by artificial lighting and ventilation, people less depend on natural conditions, and hence housing design less depends on surrounding environment.

If the neighbourhood continues that way for the next 35 years, the houses would be higher and more isolated from the surrounding. Gradually, it would be away from the sustainability in general and Green Building in particular. In other words, the scenario 1, where the process takes place as it has been done so far, would be hard to result as in the vision.

In order to go on the right track, it should need a more detail plan to reach a specific goal. That is so-called the scenario 2.

The very first need of the plan is to clarify the stakeholders and their responsibilities in the process. Briefly, besides the traditional ones involving in public and private sectors such as the related authorities and the property owners, there should be other expects and organizations encouraged to take part with a well-prepared mechanism. For instances, in order to assess whether a building is green and how green it is, the participation of organizations like Green Building Council and Consulting is crucial.

Referring from LOTUS as well as the other similar rating systems, there is always a baseline model to be compared when it comes to access and a building. That is the model reaches the minimum building standards and regulations, in the local context. First, the model should be defined, then after comparison, the building is graded. In the scale of this qualitative research, due to the variety of differences in the studied shophouses as well as lacking of the proper data on the required elements like the amount of water consumption and level of living comfort, it is not persuasive to build a baseline model, and then make a comparison. However, once enough data are collected, it could be done effortlessly by the experts following the below proposed timeline.

For the next 35 years, it would need a schedule for every single step to be linked and implemented in the long run. There would be 3 main stages: preparation, implementation and assessment.

In terms of preparation, the issues related to policies and mechanism should first be done. In the meantime, the rating system and the baseline model are built. For the case of multiple-functioning houses like shophouses, some elements in the rating systems may be modified to be more proper. Above all, participatory design is highly encouraged. Once the landlords have great awareness and willingness in the improvement, the whole process would go more meaningfully and smoothly. It would take around 5 years to plan and carry out the preparation.

Implementation is the stage that in needs of plenty of resources and time. It depends on the specific houses that the renovation, demolition, and reconstruction take place. Moreover, it is necessary to know that some changes do not pay off or express the advantages immediately. In general, it would take at least 20-30 years for the whole area to implement somewhat of its.

The progress of assessment is highly recommended to go together with implementation. After the first breakdown periods, the first renovated buildings should be taken for assessment. It would help to see whether the approach is appropriate as well as which elements should be kept and which should be changed.

Shortly, the scenarios above and the mentioned timeline are taken into account to see more clearly the possibilities to develop the neighborhood towards Green Building, as in the vision. By carrying

out the mentioned steps with the more detailed plans, in 2050, it is strongly believed that the first buildings qualified enough for a Green Building certification will no longer be a fantasy dream.

Chapter conclusion

In brief, it is obvious to see the importance to develop the studied area in the whole picture of the city. In the last years, even though the local government has had some strong moves towards their overall concepts of sustainability, the goals have been not yet concrete. In 2050, following the scenario that would need more efforts on building policies, schemes and more opportunities for the relevant organizations, the neighbourhood is in hope to have their first houses fulfil the requirements of a Green Building certification.

6. The proposals in terms of spatial organization for the studied shophouses based on references from Hoian ancient shophouses

Realizing the importance as well as the goal to develop the shophouses on Hung Vuong Street, this chapter proposes them the possible solutions from the perspective of traditional architecture. In the scale of this research, the proposals should be associated with spatial organization and its related issues.

As the research approaches the matters mainly from the point of view of traditional architecture, first of all, the rationale to referring the ancient shophouses should be discussed. Later on, the studied shophouses in Danang and those in Hoian are compared to figuring out the similarity and difference. Last, the possible green elements in Hoian ancient shophouses are selected

6.1. Rationale to refer from Hoian ancient shophouses

Referring from traditional architecture, like the case of Hoian ancient shophouses, and applying to contemporary architecture, in the case of the shophouses on Hung Vuong Street, are highly encouraged in sustainable urban development. It could be explained in the three aspects of sustainability: social, economic, and ecological.

6.1.1. Social aspect

Except for the innovations, any movement in architecture often has a certain part of accumulation. In other words, it is commonly seen in the later architecture the elements similar to the former architecture. **Architecture inherits.**

Housing architecture is not an exception. Throughout Vietnam, the vernacular traditional architecture strongly passes down on its following generations. Due to several reasons in both natural and social aspects, it is obvious to find the characteristics of the early houses in the later ones. Inheritance helps define the identity of architecture of the building, the neighbourhood, and in the larger scale, the city.

However, in the recent architectural debates in Vietnam, local architecture without local identity have been one of the most controversial topics. According to the senior architects, due to some social factors, traditional architecture gradually loses its respect in new built houses. Realizing the challenges of the cities in Vietnam in their process of growing, inheritance in architecture is highly appreciated due to its value in cultural heritage. In other words, **it contributes greatly into sustainable urban development.**

Among the old towns around Danang that are possible for being the source of references, Hoian would be the best choice for the research due to its social features. First, Hoian is considered to be one of the best conserved towns in the area that still remains the urban lifestyle of the 18th century.

Therefore, when it comes to study on traditional architecture, the town should be one of the prior choices for the researchers due to its integrity. Second, among several types of building preserved in the town, shophouse are the typical one. Hence, not the other towns but Hoian has the abilities to offer the most valuable data for the research.

6.1.2. Ecological aspect

As described in 3.3.1, and 3.4.1, Hoian and Danang have a plenty of similarities in ecological conditions. Located 30 km away from each other with almost no significant difference in topology, the two towns share their climatic conditions in common.

Due to the similarities, houses built in the two towns have to cope with almost similar challenges in terms of ecological aspect. Therefore, once the Hoian ancient shophouses meet the demands of living comfort, shophouses in Danang could also refer from to offer a liveable environment to their settlers.

6.1.3. Economic aspect

Due to the efficiency in spatial organization and other green elements discussed in 3.3.2., the ancient shophouses in Hoian reach the high level in living comfort, particularly in thermal comfort. Air conditioner is not preferred to use throughout the year; hence, the households do not consume much electricity.

The shophouse at 43 Tran Phu in Hoian is a typical example. The family has three people living on a land plot of 6m x 37.5m. The house owns the green elements of a typical shophouse in Hoian such as the deep overhangs and the inner yards. (Figure 49)

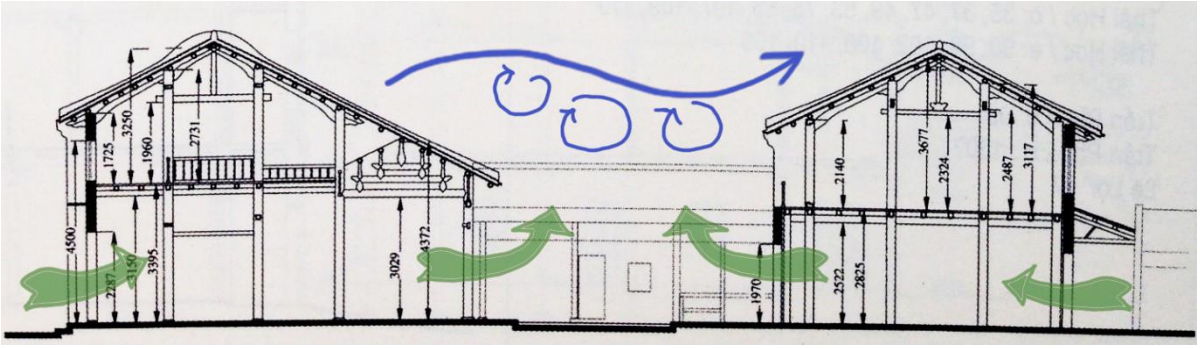

Figure 49. Section of shophouse at 43 Tran Phu, Hoi An, A26

Due to the great features in spatial organization, the expenditure spent for electricity in the last 12 months was only 5.7 million Vietnam Dong (about 237.2 EUR). The graph below illustrates its monthly electricity charges. (Figure 50)

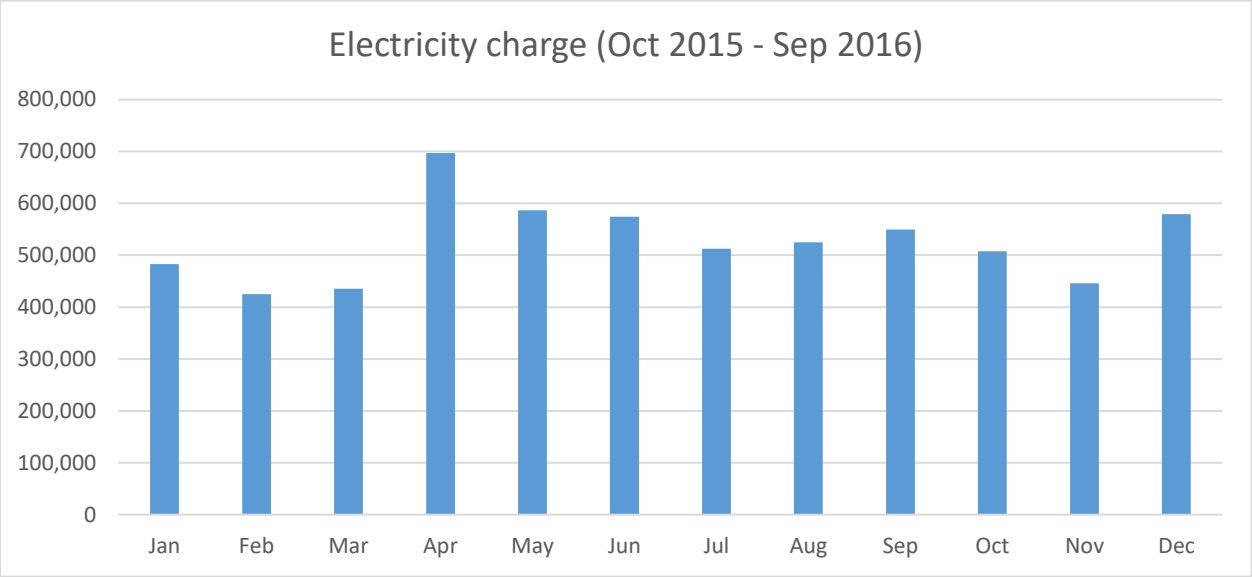

Figure 50. Electricity charge of house at 43 Tran Phu, Hoian, A27

Referring from the shophouses in Hoian Old Town, it is in hope for Danang shophouses to reduce the amount of electricity consumption.

Briefly, by fulfilling the three discussed aspects, the references from the case of Hoian ancient shophouses would have great value in the improvement of those shophouses on Hung Vuong Street towards sustainable development.

6.2. Comparison between shophouses on Hung Vuong Street and Hoian ancient shophouses

While the reasons to refer from the case of Hoian ancient shophouses stay in the similarities between them and the studied shophouses in Danang, the comparison for differences between them would greatly support the proposals to develop the studied shophouses towards Green Building.

According to the comparison table below (table 6), there are some great values in terms of spatial organization and its related aspects in Hoian ancient shophouses that could not be fully found in those on Hung Vuong Street. In other words, some green elements of Hoian ancient shophouses are either totally missing or not really there in those on Hung Vuong Street.

Table 6. Comparison shophouses on Hung Vuong Street and in Hoian ancient town, T1

Aspects		Shophouses on Hung Vuong Street, Danang	Shophouses in Hoian Ancient Town
Urban spatial organization	Land plot	Houses built on the long, narrow land plots with the similar dimensions	
		There are some gaps between every some plots for infrastructure needs and (or) the small alleys	
	Green corridor	Having no "green corridor" connecting the townhouses	Having "green corridors" running through the neighborhood
	Building orientation	Houses were mainly built along streets going perpendicular to the river	Houses were mainly built along streets going the same direction with the river
		Having only one façade that facing the main street	Some houses have the back facades facing the river
	Building height	Building height is limited at 6 stories	Building height is limited at 2 stories
Housing spatial organization (overall)	Primary spatial organization	Houses are designed follow the linear spatial organization. Rooms are connected by a hallway running throughout the house. Upper floors can be reached from one or two stairs. Some spaces are mixed-used.	
		Spaces are generally designed following orders of accessibility, but there are some spaces are not yet well located.	Spaces are designed following hierarchy order of space (access first to the served spaces, then servant spaces.
	Housing structure	Being structured like a typical "Tube-house"	Having 3 separated parts: main, bridge and rear buildings

Housing spatial organization (specific components)	Hallway	Running aside	Running in the middle
	Courtyard	Houses with 1 floor and mezzanine have no courtyard. Higher houses have the staircases working as a small courtyard.	Houses normally have 1 courtyard
	Backyard	No house has backyard	Houses normally have backyard
	Greenery	Greenery is rare	Greenery is found at the atriums
	Storage	Rarely having separating room as store, often combine store into shop space	Having separating store in a room or on the mezzanine upstairs the shop
	Bedroom	Bedroom is large, with several appliances (TV, computer, AC…) and furniture.	Bedroom is small, often enough space for only one bed. Beds sometimes are not in the bedrooms but placed in a bigger room with the others.
	Overhang	Having no overhang	Having deep overhangs
	Staircase	Staircase combines with courtyard in some houses	Staircases are small and serve no other functions.

Resulting from the table, there would be two groups of elements in the later discussion of the proposal. The first one is the used elements but not yet well function. They are highlighted cell with green. The second one is the new elements that should be introduced to the case of Hung Vuong Street. They are orange cells.

6.3. Discussion on the used elements

For a more comprehensive understanding on the connection between the shophouses of the case study and the reference source as well as what should be improved, the used elements are discussed.

It is not until now the inheritance takes place. As architecture naturally passes down on its following period, it is common to see the green elements of Hoian ancient shophouses used in Hung Vuong shophouses.

Some of them have been successfully applied. For instance, the concept of linear spatial organization and a hallway as connection path are the two excellent examples. They are totally appropriate for the building forms and functions. Besides, the continuity of spaces from commerce to residence, from the served to the servant, from the more public to the more private are well performed in most of the houses in Danang.

However, there are some used elements that have not functioned well.

First, **the hierarchy order of space** is not proper in some houses. For example, in the case of 139 Hung Vuong, the living room, which is considered as the common space for family activities, is located in the wrong place (Figure 51). Turns out, it has been the rarely used space in the house (according to the interview with the homeowner) and served as part of the storage, instead of a lively space for family reunion as expectation. Because situated far from building core (the staircase) as well as discontinued from the shared space (the dining room), it totally loses the ability to be a connecting space as it should be.

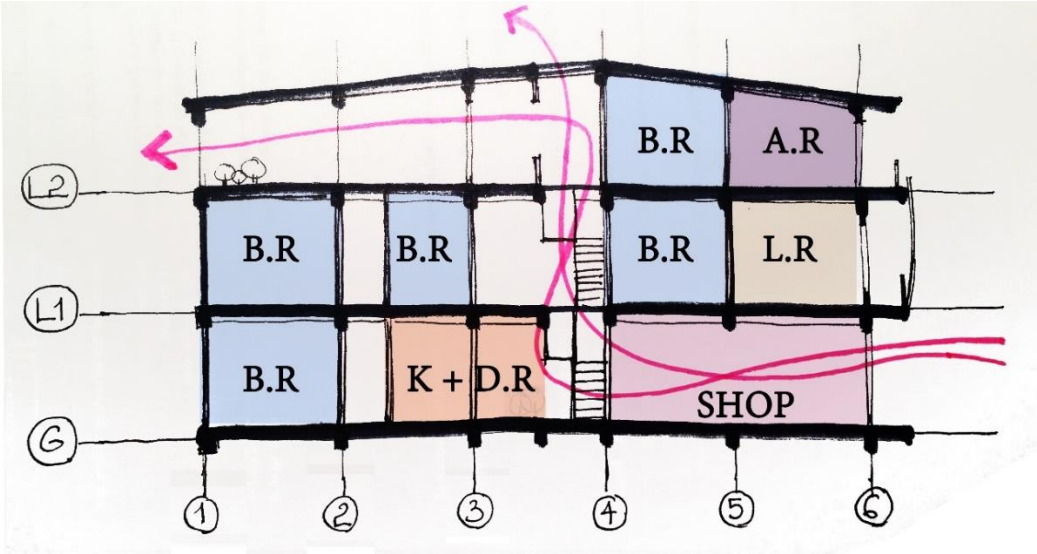

Figure 51. Section of a shophouse on Hung Vuong Street, A1

Second, **the courtyard** is not found in all houses in Danang. Normally there is an atrium combined with the staircase creating a void in the middle of the building form. However, the volume is too small comparing to the form to function as well as those in Hoian town. If it is wider and attached with some green like in Hoian, it would be the liveliest and interesting space of the house that allows the better conditions of natural lighting and aeration and plays more in its connecting role.

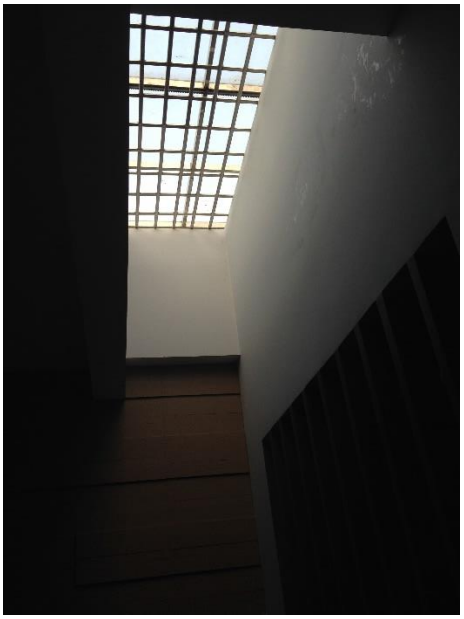

Figure 52. Staircase with transparent roof in a Danang shophouse, A1

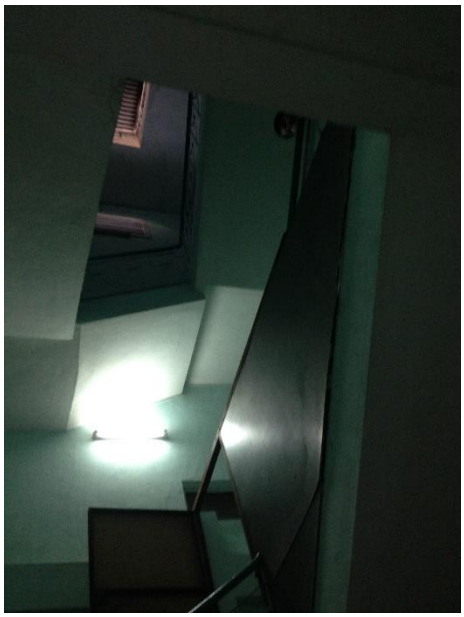

Figure 53. Staircase with flexible opening roof in a Danang shophouse, A1

Third, **greenery** is fairly rare, even though some houses have saved space for it. While plants in the houses of Hoian are arranged with a harmonizing rhythm with the space, those in Danang not yet well-paid attention. It is common to see in every shophouse in Hoian some green in several forms of local plants (Figure 54 and 55), but it is not always there in all Danang shophouses.

Figure 54. Courtyard in a Hoian ancient shophouse, A1

Figure 55. Different forms of local plants in a Hoian courtyard, A1

In order to improve the used elements mentioned above, there are solutions proposed in 6.4.

6.4. Possible solutions

Resulting from the comparison above, the possible solutions for both used and new elements are suggested. They mostly work on which elements could be improved and introduced, and how they could be done in the future, including the effect the renovation may have on the architecture, structure and programming of the house.

6.4.1. Possibilities to apply green elements referred from Hoian ancient shophouses

Realizing the desire to develop the studied shophouses towards Green Building, as well as the great meaning of references from traditional architecture in Hoian old town, it is highly encouraged to apply green elements from Hoian ancient shophouses to those in the surveyed area. However, not all of the green elements found in Hoian would perfectly fit the case study due to several reasons.

Moreover, in the author's opinion, inheritance in architecture is not only about copying some certain physical components of the older architecture into the later one. It should be about transforming the spirit of vernacular architecture into the contemporary buildings. Therefore, this part of the research discuss to which extent the green elements in Hoian ancient shophouses would be referred and applied to those in the studied neighbourhood.

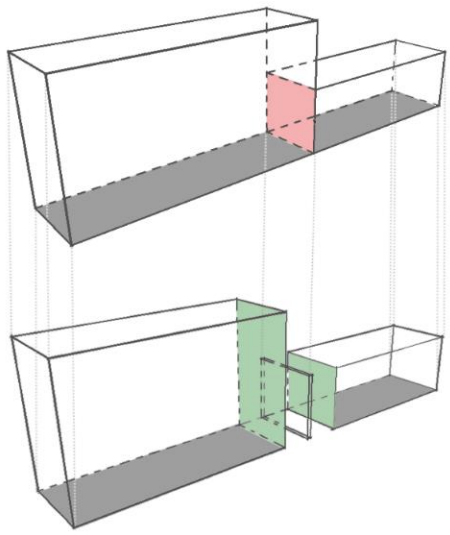

Figure 56. Conversion for opening the back façade, A1

Figure 57. Setback for an opening, A28

In terms of spatial organization in urban scale, location of the land plots, building orientation and opening direction of the facades are **the unchangeable elements**. While Hoian ancient shophouses have the higher possibilities in exposure to natural lighting and ventilation due to the

opening of their facades to the river, those in Danang have their back facades face the other houses. However, referring from the concept of opening facades for better lighting and aeration, the studied shophouses could undergo a conversion to improve the possibility to open theirs back façades. (See figure 56)

Figure 57 gives an example of how the **setback** in the back of the land plot can help improve the indoor living quality. Normally in a long building like a tube-house, it is necessary to have voids to separate the house. The voids play a vital role in communication with the outdoor environment, balance the living space as well as be the transitional room between the different spaces. However, while a vast number of houses have their voids combined to the staircase in the front part of the house, the back part have been paid attention yet. By creating a setback, it would much improve the living comfort of the settlers in several aspects. In figure 53, the kitchen are totally opened to the nature. The void creating by a setback bring natural light and aeration to the kitchen, where is always in need of them for creating a hygienic cooking environment. Especially with Vietnamese cooking style with the diversity of seasonings and high frequency, ventilation is always required. Moreover, when it comes to combine the kitchen with dining room like people often do today, the setback creates a much warmer and more comfortable atmosphere by saving space for planting a small garden.

In relation to primary spatial organization, for the house that the **hierarchy order of space** are not yet well performed, the space should be considered to rearrange. The possibilities of the arrangement highly depends on which type of spaces involved and the consequences it may cause. In other words, the more similar the old and new spaces require, the easier the conversion would be. Figure 63 would explain an example of how a shophouse in the case study would undergo an spatial rearrangement.

While the clear housing structure of Hoian ancient shophouses helps them perform well the multi-tasks without mutual affecting on each other, the compact houses on Hung Vuong Street seem not to well insulate the commercial space and residential space. However, as **housing structure is not easy to change**, references from Hoian case could not be directly apply to Danang case. Instead of restructuring the houses, the concept of spatial insulation can be transformed in the other ways.

Courtyard is an example. In both Hoian and Danang shophouses as well as all other shophouses, courtyard help insulate the front part of the building – the shop, with the back part – the house. Not only separating the space by a distance in between, courtyard also offers another sense for the living environment, which much helps for the insulation rather than only a physical distance.

Courtyard also plays several other functions. Besides those that are similar to a back yard, a courtyard also works as a communication space for different family members in the house. It is an additional space for family activities like a tea break. Figure 58 shows how a household in Hoian uses their courtyard. Not only for nature, the space is also occupied for a tea table which may be

used when a guest comes by or for family leisure time. Figure 59 and 60 capture the courtyard in a new built house in Ho Chi Minh City that would be a great example for other “tube-house”.

Figure 58. Courtyard in a Hoian shophouse, A1

Figure 59. Courtyard in Saigon House, A29

Figure 60. Section of Saigon House, A30

Deep overhang is another great element that could be transferred into the shophouses on Hung Vuong Street. Currently, the narrow setback in front of the house, especially for those facing the South, makes them receive high direct solar radiation. A wider setback for the ground floor and wider balconies for the upper floors can solve the issue.

Figure 61. The overhang above a balcony in Hoian shophouse, A1

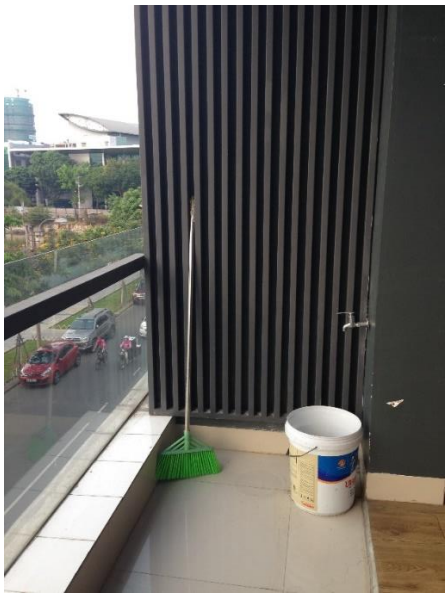

Figure 62. The balcony of a shophouse on Hung Vuong Street, A1

Figure 61 shows how the shophouses in Hoian avoid direct solar radiation as well as raindrop. Besides the proper length of balconies, roofs span far towards the front. Moreover, the height of the story is also well calculated for less direct sunlight coming through. However, houses in Danang prefer to be as close to the street as possible. In business perspective, the demand of visualization seems to be important for the shop that they need to reach close to the street and catch people's eyes when they go by. In housing point of view, it is because of the need of space, the house always maximizes its built area for use. However, maximizing does not always mean optimizing. For a better indoor living comfort, saving space for a front setback and deeper overhang is recommended.

The opening of the roof above the staircase should be encouraged to be opened and widened for communicate with the outdoor environment. The more transparent the roofing material is, light is more likely to go through. It also should be flexible in use, especially in hot summer days or heavily rainy days.

Figure 63. Green corridor creating with green space in courtyards, A1

Referring from Hoian shophouses, **greenery area** should be paid more attention. Saving spaces for plants in the courtyard and backyards, they are grown not only in small pots or around the fishponds but also in vertical wall. This is highly recommended for houses in the dense areas like Hung Vuong Street.

Together with the courtyards, the flexible opening roofs on them and greenery, a **Green corridor** passes over the row of shophouses is formed. Figure 63 illustrates how it would look like as well as its advantages. Similar to Hoian ancient shophouses, the green corridor is a space creating by series of the continuous green spaces even though they are not totally coincide on a straight line. Normally those spaces are void, so the green corridor serves as a wind path of the neighborhood. The blue arrow explains how wind blows upon the houses based on the difference in air pressure.

6.4.2. Proposed conversion for the studied shophouses in terms of spatial organization

Towards Green Building, houses in the surveyed area should undergo conversion to complement the mentioned elements. Because different buildings are in different situations, the process to convert them are not always similar. Hence, this part of the research proposes the possible suggestion for those houses based on their own conditions.

There would be two groups discussed below. The first one is the group of the degraded houses that are probably demolished in the next years. The second one is the remaining that may undergo a conversion at some points to be improved.

For the first group, the shophouses have been in not good conditions enough for living. A part of them, the dormitory, would be soon acquired by the department of construction, and undergo the demolition. The remaining would be rebuilt by their homeowner when the budget allows. The houses have 1-2 stories, so their life expectance would be from 20 to 50 years old. First constructed before 1975, they have been 40 years old and would be soon out of their life spans.

Once the new house is built, the discussed elements in 6.3.1 are highly recommended.

For the second group, the conversion would depend on the current conditions of the house. In other words, the house would be converted for complement the missed elements. The following content would be described as the order of elements mentioned in 6.3.1.

- **Setback in the back part of the house**: There are two types of works should be done for it. For the house that already has had the setback but not in the good condition or not supply enough space (see figure 64), a renovation for widen the setback should be done. For those that do not have any space ready for a setback, the room in the end of the house would save a part of

its space for the setback. In case it is impossible to find some place for the setback, another courtyard could be the replacing offer. However, the total amount of workload would be much more than creating the setback since a courtyard in the middle of the building mass will involve several parts of the house. Either work with setback or an additional courtyard, the building structure and material should be well calculated.

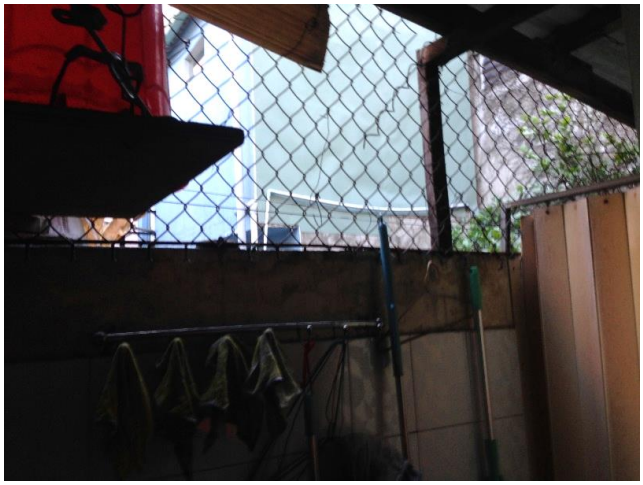

Figure 64. The opening void of a shophouse that is in need to be widened, A1

Figure 65. A small vegetable garden on the terrace, Hung Vuong 139, A1

- **Hierarchy order of spaces:** As mentioned above in 6.3., some houses have not yet arranged their spaces properly. In addition, it depends on the difference demands of the former and conversed spaces that the conversion takes place. In some cases, it would effect on the building structure as well as the technical support to change the function and location of a certain room in a house. However, sometimes it does not involve much works, but the result is greatly different. For instance, the house illustrated in figure 51 deals with the issue that the living room is located at the improper place. In this case, if the family and their guests would like to access the space, they have to across a bedroom on the way. Because of the inappropriate spatial arrangement, the activities of a public space would disturb the private space. Dealing with that, it could be better if the bedroom and the living room exchange their space (See result in Figure 66). The wall separating the staircase and the former bedroom is removed to creating an opening space for the living room and connecting them to the shared spaces nearby. The conversion is doable and even simple because those 2 rooms have no special technical problems and currently, they are also similar in dimension.

- **Courtyard and roofing of the staircase**: For houses that do not have a courtyard, the work would be similar to what have been discussed in the last paragraph. Normally, the location of the courtyard in the house will be chosen with consideration to the structure and material of the house. In a shophouse, often people design their courtyard in between the shop and the house. It is fairly common to see staircase also in this position. Therefore, a courtyard combine with the

staircase could be done. One of the primary condition of a courtyard is its ability to communicate with the outdoor environment. Hence, choosing a proper dimension for opening on the top of the staircase, the material of the roof as well as its flexibility are important.

However, the courtyard and the opening roof would play as a chimney when the house is in on fire. The higher the building is, the more risky it is. In the townhouses that have only entrance like that, the settlers should be aware that the only way to get an escape is from the terrace or the front balconies when the main entrance on the ground floor is blocked or inaccessible.

- **Deep overhang and balconies:** In the author's opinion, this is one of the most difficult tasks of the shophouses. The problem does not involve much with architecture, but the mind-set of the shop runners and the homeowners. As discussed above, the store would like their products to catch people attention, and the homeowners would like to maximize their built space; therefore, the front part of the house is always close to the street with the shallow setback and balconies. However, rather than creating a deeper overhang, the direct solar radiation and raindrop could also be blocked in another way. Louvre can be the replacing method.

- **Greenery area:** The element is flexible to be done by different place and different ways. Not only in the yards like Hoian ancient shophouses, green can also be planted on the terraces and the balconies. Recently, families in Danang start to have their own garden for vegetables on the terrace. This kind of garden can also be found in the studied neighbourhood and is highly encouraged. (See figure 66)

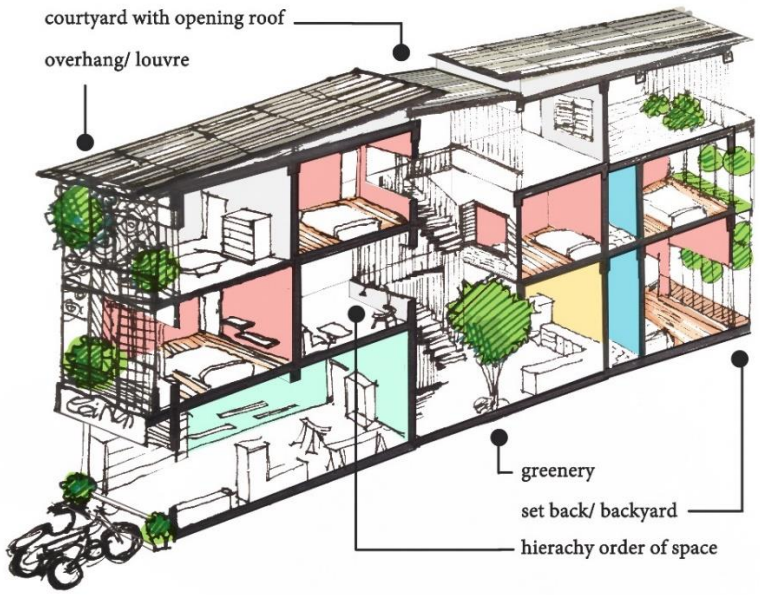

Figure 66. Summary of proposals and their related elements, A1

In short, the 6 mentioned elements and proposed conversion could be combined in the following illustration, which is a cross-section in 3D view. In Figure 66, a setback is created for the 2 bedrooms in the back of the house have a “breathing” space. The order of spaces is also rearranged as discussed. Courtyard with flexible opening roofing is recommended. Louvre is the replacing solution for a deep overhang. The house also becomes greener with plants in the transitional spaces including the entrance, balconies, courtyard, and the setback.

The order of the elements complemented into the house depend on every single house. Moreover, for all of the elements discussed, the shophouses may have less area for the furniture. However, the less would not mean the worse if the homeowners really understand their needs and know the way to use one space with more than one single function.

Chapter conclusion

Briefly, from the perspectives of sustainable urban development, references from Hoian ancient shophouses is highly encouraged for the case of shophouses on Hung Vuong Street, Danang. Among the green elements, the selected are analysed to propose the possible solutions. Based on the suggestion, the conversion to improve the shophouses and their consequences are discussed. Although the development involving much more changes rather than those related to spatial organization, the proposals are in hope to help the neighbourhood to be closer to its expected goal in 2050.

7. Discussion and Conclusion

For a comprehensive understanding on the research problems and the finding, the final chapter discusses the different possibilities that may affect the results of the research. In the end, it provides the overall view on the entire study.

7.1. Discussion

In general, the research is in hope to figure out the main characteristics of spatial organization of shophouses on Hung Vuong Street and look for a way to improve them towards Green Building. However, **spatial organization is not the only element** need to be studied even though it is crucial in a good design. Out of it, there should be several aspects to be well considered and changed to reach the desired goals.

As stated in the scope, when it comes to improve a certain building, several possible solutions may help. Traditional architecture is just a source of references between many other sources. In the perspective of sustainability, due to its meanings in all 3 aspects, it is no doubt that **referring from the traditional architecture is highly appreciated**. It, however, **does not cast down on the value of the other reference sources** because each of them has their own unique values. Moreover, in the ages of hi-tech development, the introduction of new technologies, those that could not referred from the past, would help much on the way towards Green Building,

In research, different methods would result differently. Even though with the same method, the results is not completely similar. The deeper that the author digs down, the more the approach can figure out. In this research**, it would be more applicable if there were more people participated in the interview**. A survey on several issues such as the awareness of people about Green Building, their desire and difficulties in housing renovation also can be carried out. Moreover, the baseline model, which is in need for Green Building assessment, requires a plenty of data that may be collected in a fairly long time with different methods.

LOTUS is referred in the research as the rating system for Green Building assessment. Although it has been generally used in Vietnam recently, it has been not yet totally worked for a multiple-function building like a shophouse. Modification may be required to be more precise. Also, for new built houses, LOTUS R would be the good choice, but for houses in operation that meets LOTUS BIO, it can be another option.

Additionally, the Green Building rating system like LOTUS would need first a baseline model. This research would be more completed if the baseline model is an existing data used for assessment to see how far the shophouses currently are on the way towards Green Building and what need to be changed in the future.

Sustainable building is an essential part of sustainable urban development. Because Green Building does not cover all of the issues in sustainable building (Clare Lowe & Alfonso Ponce, n.d.), it would be not the only concept to deal with. Especially in the current context of Vietnam, the awareness of Green Building is not yet high, and "green" and "sustainable" are used interchangeably sometimes; there are much more aspects taken into account besides Green Building. They include social and cultural issues, economic considerations, and urban planning and transportation issues. Those issues more or less affect each other, so an integration plan definitely is first in need to develop the city in general, and the studied shophouses in particular. (Figure 67)

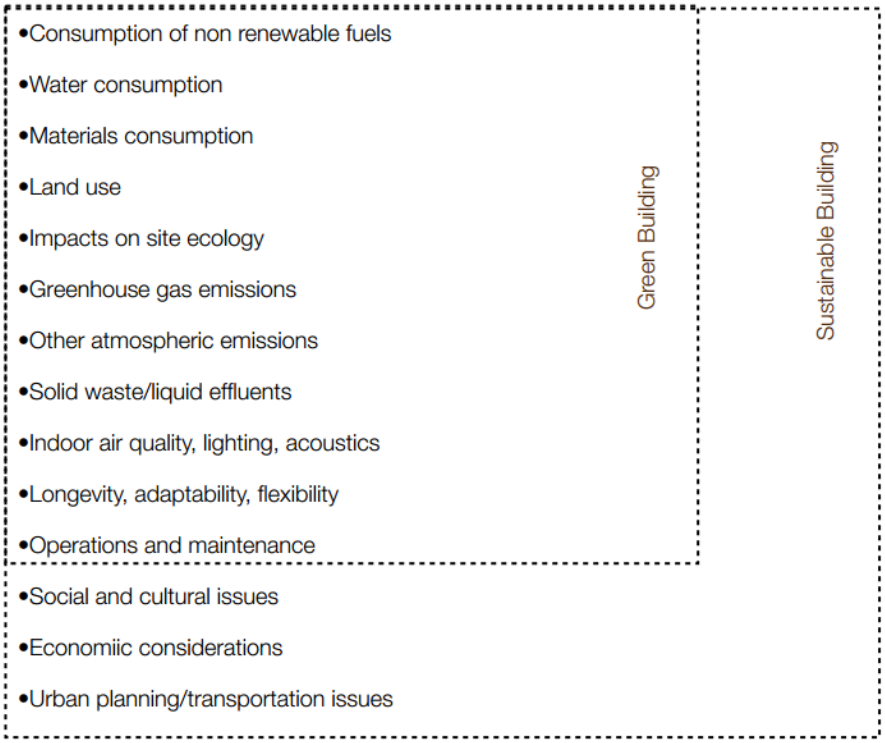

Figure 67. Relationship of Green Building and Sustainable Building, A31

7.2. Conclusion

In the last years, rapid urbanization has taken place in all cities of Vietnam with both positive and negative consequences. Realizing the important role of sustainable urban development, there have been several projects and research working on all aspects of the issue. Within the scale of sustainable building, the research studies on spatial organization of shophouses on Hung Vuong Street and their development towards Green Building, based on references from Hoian ancient shophouses.

The studied shophouses on Hung Vuong Street are built similarly to a “tube-house”, the typical building form of townhouses in Vietnam. Following linear spatial organization, the current programming generally meet the basic demands of the buildings. However, due to some limitation, the houses is still in needs to consider and improve their spatial organization in order to step up towards Green Building.

The surveyed neighbourhood is located in an important part of the city and play a vital role in the whole picture of the urban development. Recently, even though the local government has had some strong moves towards their overall concepts of sustainability, the goals have been not yet specific. In 2050, following the scenario that involves more of building policies, proper mechanism and opportunities for the relevant organizations, the neighbourhood is in hope to have their first houses fulfil the requirements of a Green Building certification.

In order to attain the goal, references from Hoian ancient shophouses is highly encouraged for the case of shophouses on Hung Vuong Street, Danang. Among the green elements analysed from local architecture in Hoian, the selected are used to propose the possible solutions. Based on the suggestion, the conversion to improve the shophouses and their consequences on architecture as well as construction are discussed.

In conclusion, by looking on the three research questions, the study finds out and analyses the characteristics of spatial organization of shophouses on Hung Vuong Street as well as ways to develop them towards Green Building based on selected elements from the local traditional shophouses. By the findings, the research would be another helpful source for practical application in architecture design and theoretical reference for further related research.

LIST OF TABLES

LIST OF FIGURES

SOURCES OF TABLES

T1 – Author

T2 – Danang UPI

SOURCES OF FIGURES

A1 – Author

A2 – Tan Yeow Wooi

A3 – Francis D. K. Ching

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A23 – Google Earth

A24 – Khai Dat

A25 – Danang Urban Planning Institute (Danang UPI) (Edition from author)

A26 – Showa Women's University

A27 – Vietnam Electricity (EVN) (Edition from author)

A28 – vuonxanhnhaxinh.com

A29 – Quang Tran

A30 – A21 Studĩo

A31 – Clare Lowe and Alfonso Ponce

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